

AGRICULTURAL LAND EVALUATION:
THE ADAPTATION OF THE LAND EVALUATION
AND SITE ASSESSMENT SYSTEM TO THE MICROCOMPUTER

BY

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CHAPTER I

INTRODUCTION

"Will we have enough land to produce the food and fiber we will need in the 21st Century if the present rate of land development continues?" This is the question William Whyte posed in the 1981 Agricultural Year Book in his essay on "The Land and Water Squeeze on Our Food."

The agricultural crisis in the United States is a complex and diverse issue, with many of the symptoms of a declining industry. Those persons who have looked at the multitude of problems facing the American farmer have analyzed the situation from their own viewpoints. Each analyst has his own scenario. Some paint a gloomy future for American agriculture while others hold out hope, trusting in American ingenuity to find solutions.

One agricultural issue which has received a great deal of attention over the past decade is the conversion of agricultural land to other than agricultural production uses. The loss of farm land to nonagricultural uses is

often more dramatic and can be witnessed by people who have little knowledge of agricultural economics or the plight of the family farm.

In most cases it is the best farmland which is also most desirable for non-agricultural development. The term development, as used in the planning sense refers to all industrial, commercial, residential, transportation, and some intensive recreational uses. Suburban housing subdivisions, energy, transportation, reservoirs and other uses which consume large portions of the landscape are bidding for agricultural land at a level that often excludes agricultural interests.

In recognition of the need to protect farmland, Congress passed the Farmland Protection Act-Public Law 97-98 (1981) (see Appendix A). As part of this federal legislation to protect the agricultural land resource, the Soil Conservation Service (SCS) was given a mandate to implement a system to assist in the identification and evaluation of agricultural land that should be retained for agricultural use. The system which the Soil Conservation Service implemented is known as the Land Evaluation and Site Assessment System or LESA (USDA, 1983).

The LESA System was developed as a tool to assist decision-makers at all levels of government, who are responsible for land-use planning. Land-use planning procedures are designed to synthesize available landscape assessments so that decision-makers have the environmental information necessary to make sensible land use and management decisions. LESA can be used by planners or other decision-makers to rate or compare one or more land parcels for the purpose of determining the specific value the parcel has to the agricultural land base of the community or region. As a tool, LESA can only synthesize information into a meaningful form, for it is ultimately the decision maker who has the final responsibility to determine the tradeoffs among alternative future land use possibilities.

The intent of this study is to utilize the present Land Evaluation and Site Assessment (LESA) system and adapt it for use with an electronic spreadsheet run on a microcomputer. By using the electronic spreadsheet to eliminate the need to manually manipulate the LESA scores, more options can be considered in a shorter period of time.

For research purposes a study area will be used to evaluate the application of the microcomputer adapted LESA system. The study area which has been selected is the Wamego area of Pottawatomie County, Kansas which lies in the Kansas (Kaw) River Valley (Figure 1.1).

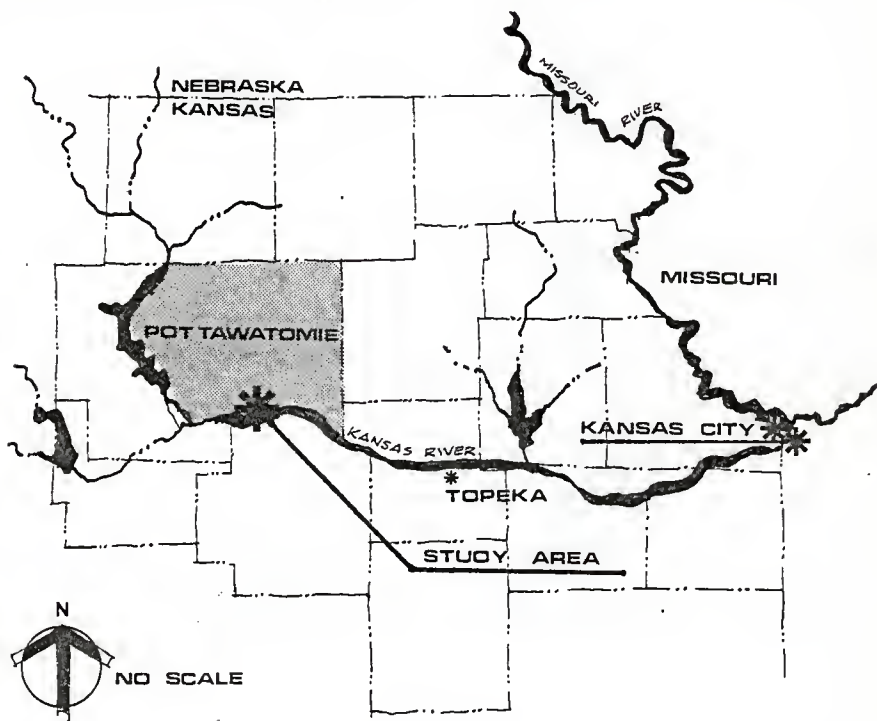


Figure 1.1 Location Map: Pottawatomie County, Kansas.
(Source: National Atlas, 1970)

CHAPTER II

BACKGROUND

THE AMERICAN AGRICULTURAL LAND CRISIS

Farmland is one of America's most valuable natural resources. This nonrenewable natural resource is now under considerable development pressure. Agricultural land is being converted to non-agricultural uses at an alarming rate. Possibly as much as three million acres are lost (taken out of production) annually. As many as two million are lost to land speculation while an additional one million are lost due to the isolating effect of suburban sprawl (USDA, 1981; Klein, 1982). For all practical purposes, the loss of these lands to U.S. agriculture is irreversible. There are several reasons or forces acting together to cause this change. Factors such as the cost of land in the marketplace, the cost of doing business on the family farm and the

competition between industry and farming for land with the same physiographic region all contribute to the process of change.

This chapter is not intended to be a comprehensive review of literature on farmland protection or the problems facing the family farm. The emphasis is directed toward the planning issues and concerns which brought about the development of the Land Evaluation and Site Assessment (LESA) System. The issue here is not whether we have a farmland crisis, but to demonstrate that the tools for evaluating the agricultural resource be enhanced to better assist those who must make the resource allocation decisions.

Farmland protection is a controversial issue. Part of the problem may be semantic. In the literature the words preservation and protection are used interchangeably. This may lead many readers to assume that development and farmland protection are mutually exclusive.

Preservation decisions imply that an attempt is being made to maintain a piece of land in its existing state. No direct change in human use patterns is allowed, although indirect benefits to society may accrue from the preserved land (Gustafson, 1981). For example, it is often argued that the coastal wetlands should be preserved in their natural state to maintain the uniform exchange of nutrients necessary to sustain marine food cycles, which in turn insure the viability of fishing operations.

The purpose of farmland protection is to assure that if farmland is converted, it is by deliberate public choice rather than default. Farmland protection programs should provide for the selection of land which only merits preservation under the program guidelines. Protection, or conservation implies limited use within specified guidelines. These guidelines are established to protect the most valued attributes of the protected area. Thus for the purpose of this thesis, the appropriate term applied to agricultural land should be protection rather than preservation.

There are fundamental differences between important farmlands and other agricultural lands. Recognition of these differences is important in determining the course of farmland protection programs. Important farmland must be distinguished from less important agricultural land. The definition and identification of important farmland is crucial in the development of a viable approach to the regulation of farmland conversion. Any program which defines and restricts the use of large areas of private property should have broad-based support at the local and state level.

Gustafson (1981) states that any program for protecting important farmland should be administratively flexible. Since there are economic substitutes for the best farmland in agricultural production such as marginal land and non-agricultural inputs such as fertilizer, a program for restricting use cannot be absolute. Specific criteria must be established to determine when it is in the public interest to allow the conversion or protection of farmland (Gustafson, 1981). Therefore, it is important for the public decision makers to have a means to evaluate the individual, relative value of farmland parcels.

At some point there is a limit to the size of and extent to which suburban parcelling can be carried by agricultural areas (Gustafson, 1981). Beyond a certain size, the small parcel can no longer sustain production agriculture, increasing the cost of agriculture on society. Just where this limit is creates disagreement, not only over size and location, but over procedure as well. By whom and with what criteria will the decision be made? The choice of land management techniques is crucial to the policy-making process.

AGRICULTURAL LAND BASE

William Whyte (1981), in his review of the National Agricultural Land Study (NALS) published in the 1981 Agricultural Year Book, explains that there are

about 540 million acres of land which is America's cropland base. This land has a high potential for producing crops. Of that 540 million, 413 million acres are readily available as cropland. The remaining 127 million acres are considered to be potential cropland. Most of this land is currently in pasture, rangeland (of which one-third is forested), or in other uses. Hence, the cropland base figure constitutes only part of our agricultural land resource base (Figure 2.1).

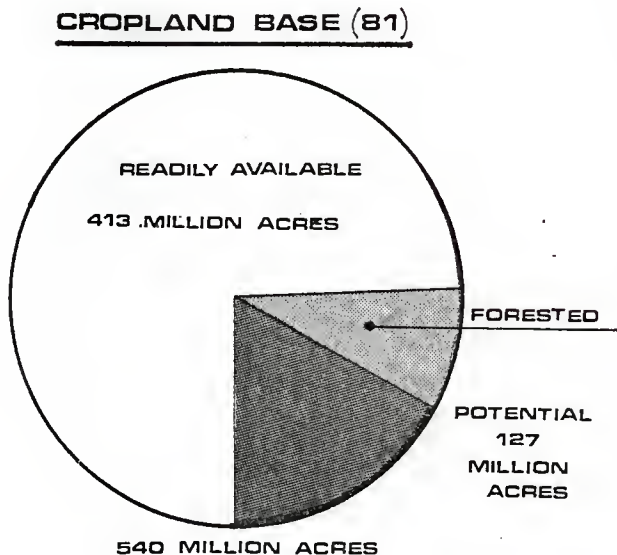


Figure 2.1 Cropland Base.

(Source: National Agricultural Lands Study. USDA, 1981)

The Final Report of the National Agricultural Lands Study (NALS), released on January 16, 1981 states:

"As a resource problem, the conversion of agricultural land does not constitute a present day 'crisis' and hence it lacks the equivalent of, say the gasoline line for concentrating national attention. Nevertheless, it does pose some very serious longterm risks for the United States. In a sense, the issue of protecting agricultural land today is analogous to the energy conservation issue ten years ago. Looking ahead, we can see a resource problem developing but the immediate incentives for conserving the resource are weak."

(USDA, 1981. p.1)

More specifically, the 1981 Final Report of the National Agricultural Lands Study emphasizes the primary role of state and local governments in conserving agricultural land and the supporting role of federal agencies. The 1981 NALS report made the following recommendations for action at the state level:

1. State governments should assume an active role in protecting prime agricultural lands,
2. National interest in agricultural land should be articulated in a presidential and congressional policy statement to aid states and localities in their own initiatives,
3. Single purpose federal assistance programs should be coordinated at the state or local level to insure that agricultural land issues are adequately addressed in state and local planning efforts,
4. The USDA and other federal agencies should provide technical assistance to state governments requesting aid in developing land protection programs or policies,
5. The USDA should assess the feasibility of providing small matching grants for capacity building to state agricultural departments to manage agricultural land programs,
6. The USDA should develop a capacity for providing state or local governments with detailed statistical information collected by federal agencies.

Although the national significance of farmland loss is subject to debate, many state and local governments have considered it important enough to adopt farmland preservation programs. Unlike earlier efforts that simply preserve open space or curb urban sprawl, most of these programs focus on protecting farmland for the purpose of keeping land available for farming while also attaining aesthetic and environmental objectives.

For those concerned about long-term food supplies, the rapid conversion of productive agricultural land to other uses has been a constant source of frustration. Many authors (Lapping, 1979; Steiner and others 1981; Steiner and Theilacker, 1984) have addressed the need to protect good agricultural land. Soil Conservation Service soil scientists and planners have developed and used a number of systems for identifying and protecting these lands. There is a dilemma confronting planners in many areas of the United States. By the end of the 1980's, 95 percent of all Americans will reside in an urban area, while only 5 percent will remain on the farm (Batie and Healy, 1980).

Due to increases in population in areas such as the Colorado front range; King County, Washington; and the region around Washington, D.C., land will be needed to provide an adequate supply of both food and reasonably priced housing. The problem then becomes two-fold. It is an urban problem as well as a rural problem. How do we meet the food and housing needs of and provide open space for the urban population while protecting the family farm and agricultural land resources at the same time?

To resolve this issue, policy-makers must be able to identify, for protection, those lands that are most suitable for agricultural use. Once this resource base has been identified, the necessary urban development can be guided away from the best land to areas less suited to agriculture production.

DEMANDS ON AGRICULTURAL LAND

Within the United States, there are several agriculturally important regions which are experiencing rapid rates of farmland conversion including the dairy country of New England, the citrus and vegetable growing areas along the East coast, the citrus regions of California and the fruit and vegetable producing valleys of the Pacific Northwest. Projections indicate that up to 60 million acres of agricultural farmland will be taken out of production between 1970 and 2000; as much as 60 million acres of farmland will be consumed by urban expansion, water projects (reservoirs), parkland and other recreational facilities. Batie and Healy (1980) state that a majority of these lands lie within the 242 Standard Metropolitan Statistical Areas (SMSAs) (Figure 2.3).

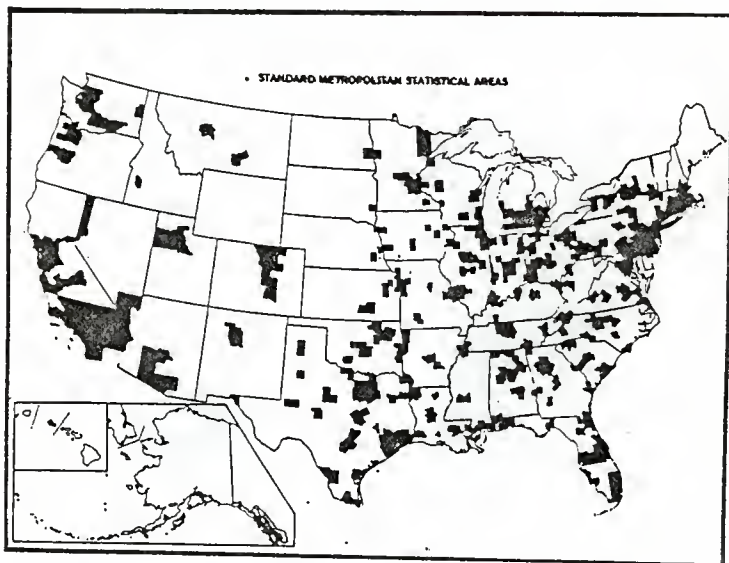


Figure 2.3 Standard Metropolitan Statistical Areas.
(Source: Sanders and Rowntree, 1981)

The continued loss of prime agricultural land in the metroplitan areas will have a marked impact on several important food products, especially vegetables, 60% of which are grown within these metropolitan areas. In total, approximately one-fifth of all the food produced in the U.S. comes from farms within metropolitan areas (Patton, 1975).

Urban Pressure on Cropland

It is no accident that the major population centers are located in some of America's best farmland. America was developed on an agricultural economic base. A majority of the country was settled as a result of speculators promoting the agricultural value of the land. The best land was able to support the most people, consequently more people settled in the regions with the most productive land resource (Figure 2.4).

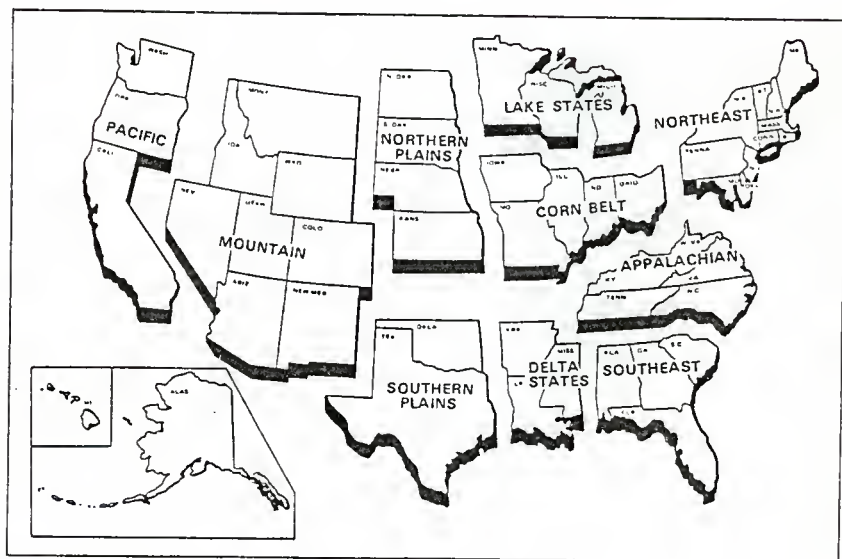


Figure 2.4 Crop Production Regions.
(Source: National Agricultural Lands Study, USDA. 1981.)

It is important to note that metropolitan areas contain a significant proportion of the agricultural land classified as "prime" by the U.S. Department of Agriculture. The soils with the highest natural productivity contain a large amount of organic humus. These soils hold moisture well, are relatively rock free, and are well drained. Soils with these characteristics are rare and classified by the Soil Conservation Service as Class I soils. Of the 465 million acres of cropland in the United States, only 72 million can be classified as Class I soils. Over half of these 72 million acres are within metropolitan areas. Nearly 15% of the total prime agricultural land is found within the SMSAs (Miner, 1976).

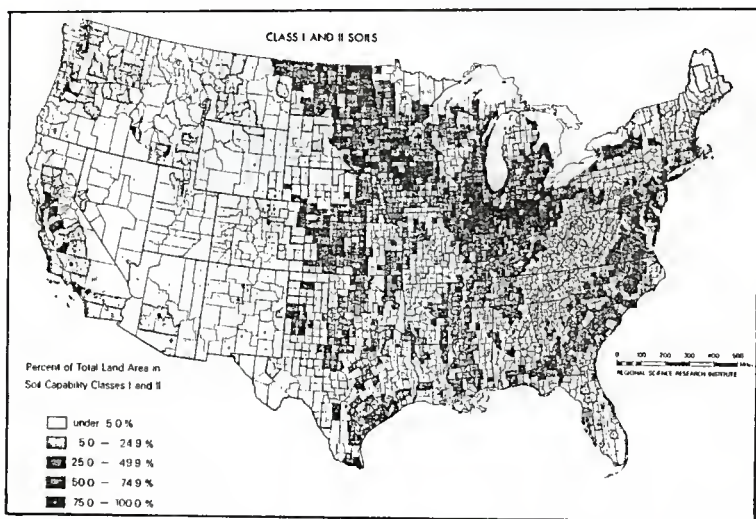


Figure 2.4.1 Distribution of Class I and II soils.
(Source: USDA, 1981.)

The loss of prime farmland to urban uses has been particularly high in the Northeast. For example, 50% of the land converted to urban uses between 1950 and 1960 was farmland. Of that, 80% was classified as "prime". California has lost between 15,000 and 20,000 acres of prime agricultural land each year over the last twenty years. The annual net loss is expected to increase to 25,000 acres. New York, the nation's second most important dairy production state, has experienced similar rates of loss (Miner, 1976; Berry and others, 1976).

Another argument often employed to support public policies designed to preserve agricultural land is that the operation of the market economy does not result in efficient urban development. Urban sprawl is more expensive to urban populations than compact residential growth. This is primarily due to the higher costs of extending public services. High density residential development may also result in lower environmental costs and natural resource consumption for a given number of dwelling units (Coughlin, 1977). Keller (personal interview, 1984) has stated that had all cities in the United States developed at the density of the Minneapolis, Minnesota interior city core, the United States would be a net exporter of crude oil.

Raup (1976, p.180) commented that the "market consolidates urban demands into the value structure of rural lands far in advance of any real need for the lands for urban expansion." When rural land values increase, taxes go up and the expectation among farmers of the future profitability of farming decreases (Plaut, 1976). With this uncertainty comes reduced reinvestment in capital resources that maintain a profitable agricultural industry. One result is the inefficient idling of farmland before it is necessary. This could be avoided through effective agricultural protection policies (Gibson, 1977).

Harriss (1980) believes that in a wide-open land market, farmland in the path of suburban growth is doomed. A farmer cannot compete economically with rising costs associated with the inflated land values and accompanying

development pressures. In a very direct sense, development pressures turn a farmer into a willing or unwilling speculator (Miner, 1976; Coughlin, 1977). The increases in land prices have been both a boon and a burden to the farmer. Inflated land values will preclude some farmers from buying more land for production. This is especially true for the new farmer. But, on the other hand, the higher land values have given the larger farming operations collateral to expand both equipment and land holdings (Darling, 1984 personal interview; Harriss, 1980).

The supply of harvested cropland can be reduced by urban effects other than direct conversion and real estate costs. With the intrusion of residential development into rural areas, the farmers that remain tend to lose political, economic and social status. This loss of status may result from the implementation of regulations and zoning ordinances which preclude many farming operations that are considered, by the new residents, to be nuisances.

Another result of urban pressure on agricultural land is the idling of cropland. The "leap-frogging" (Plaut, 1976) of residential subdivisions and office parks not only removes cropland from production but also idles surrounding land at the same time. Plaut (1976) has termed this a "spillover effect". Spillover effects can be defined as actions taken or caused by urban people which interfere with routine farming activities. If these effects become severe enough the farmer will move elsewhere or quit farming. Typically, these effects result in costs to the farmer that make his activities less profitable or less efficient.

Five spillover effects cited by Plaut (1976) include:

1. Regulation of farming activities that are deemed nuisances by the new residents of the area.
2. Increased taxation to pay for new schools, roads, utilities and other services required by the new residents.

3. Air pollution damage to crops caused by automobiles or industrial activity or even residential space heating.
4. Destruction of crops or equipment or harrassment of farm animals by children and adults from the suburban development.
5. Use of eminent domain to acquire farmland for public uses aimed at serving the new suburbanites, roads and reservoirs are the two most important uses of land acquired by eminent domain.

Plaut was able to quantify the spillover effect by calculating the ratio of acres of cropland idled to those actually converted to urban uses. These ratios ranged from 0.5 acre:1 acre in the Midwest to 1:1 in the Northeast. Spillover is less likely to occur in the Midwest than in the Northeast. This is partially due to the cropping system in the Midwest and also because of the better quality soil which farmers are less likely to abandon. On the other hand dairying in the Northeast is more sensitive to the pressures of development. Needed capital investments may not be made in the dairy operation as the sale of land to developers becomes more attractive (Plaut, 1976; Lapping, 1980).

BENEFITS OF PROTECTING THE AGRICULTURAL LAND BASE

Gardner (1977) identifies five joint benefits that have characteristics of public goods (benefits) which provide a rationale for public policies designed to preserve agricultural land. Joint benefits of agricultural land preservation are defined as benefits that accrue to others as well as those who continue to operate the farm. They are:

1. The provision of sufficient cropland to supply the food needs of an expanding national and world population.
2. The maintenance of healthy local economies in predominantly agricultural areas.

3. The increased efficiency that results from more orderly urban development.
4. The reduction of resource misallocations resulting from the conversion of the better agricultural lands to other uses.
5. The provision of open space in rapidly urbanizing areas.

Food and Fiber Production

One of the major benefits commonly identified to support agricultural land preservation is that preservation is necessary to guarantee the cropland base to meet the growing demand for food and fiber.

Between 1950 and 1972, agricultural productivity rose 67% (Krause and Hair, 1975). This was a time of greatly improved agricultural technology and crop varieties. Projections suggest that productivity per acre will continue to rise, but at a slower rate (Economics, Statistics and Cooperative Service and Foreign Agricultural Service, 1977). Schneider, in his Book of Genesis, (1976) called for a "Genesis Strategy", whereby agricultural output is stored in good years to tide us over during the bad years.

In the 1977 Soil and Water Resources Act assessment (Lee, 1978), it was projected that for the United States to satisfy moderate export demands and domestic consumption by the year 2030, 462 million acres of crops will be necessary. Under less favorable weather conditions as much as 407 million acres must be harvested to meet export demand in the year 2000. This represents a 71 million acre increase over acres harvested in 1975 and would necessitate the development of new cropland as well as a 1.1 percent increase in productivity each year (Lee, 1978).

Major expansion in the world cropland supply or development of new cropland is not likely. The remaining arable land in the world is generally lower in productivity than that which is already in use. These lands are remote

and would require large capital investments to develop. The agricultural infrastructure and transportation facilities are usually inadequate in these regions. Since worldwide supply of cropland is not likely to increase dramatically, the demand for agricultural products from existing lands is likely to increase (Carter and others, 1975). Therefore, it is important to protect the land already under cultivation and to increase the productivity from it.

Global productivity will determine the demands placed upon United States cropland. The greatest food deficits resulting from the lack of high yielding cropland and/or famines are most likely to occur in countries that are the poorest, and consequently least able to afford the market price for food exports. In the event of a famine or a natural disaster, a political decision would have to be made by the United States and other food-exporting countries as to whether food aid would be given to the stricken countries. The granting of such aid will add one more source of demand upon the output from the limited cropland supply in the United States (Schiff, 1979).

Gibson (1977) cites another market anomaly which can be avoided through the protection of agricultural land. This anomaly is the problem of resource misallocation. He identifies two non-mutually exclusive resource misallocations. The first concept assumes that better land produces fewer environmental costs than lower quality agricultural land, because fewer inputs of energy, chemicals and erosion controls are necessary for optimum production. Economically speaking, better land can be substituted by marginal land with the addition of higher and more intensive management techniques which in turn increases environmental problems. The second concept states that the conversion of agricultural land to urban uses may eliminate the future productive capacity of the farmland base, such conversion tends to be irreversible (Gibson, 1977; Whyte, 1981).

Crosson (1977), Batie and Healy (1981), and other economists discuss the relationship between future technology and cropland supply. Technologies are termed "land-conserving" if large amounts of non-land inputs are utilized. The primary non-land input for increasing production is fertilizer (others include machinery, pesticides, supplemental irrigation and certified seed varieties). Crosson reports (1977) that the marginal productivity for fertilizer fell sharply between the early 1960s and the late 1970s. This reflects a general decline in the productivity of "land-conserving" technologies.

Prices (and supply) of fertilizer, energy and water are likely to continue to increase thereby reducing the attractiveness of these technologies. To maintain the same level of agricultural output, cropland which is normally fallowed and marginal lands which are not in production will have to be placed in production. Crosson (1977) terms these practices as "land-using technologies". The increasing price of farmland and government policies which require adequate erosion control measures may reduce the attractiveness of developing marginal land and abandoning crop rotation and fallowing systems of crop production.

Without some disincentives placed on the development of marginal land, the market system could lead agriculture into another environmental debacle far more disastrous than the "Dust Bowl" of the 1930s (Worster, 1984).

Open Space Value of Agricultural Land

One of the most commonly cited attributes of preserved agricultural land is that such land provides open space for urban population centers. The aesthetic benefits of open space are generally not reflected in the market price of land (Darling, 1984 personal interview). This is because provision of open space has the characteristics of a public good (Gardner, 1977).

The preservation of good cropland and the provision of open space are two separate issues even though there may be a strong relationship between highly productive cropland and open space preservation for aesthetic reasons or "urban recreators". Social values are recognized by planners and park agencies in their plans for open space acquisition. Agricultural lands are a form of open space that present a broad range of values which Miner (1976) summerized as:

1. Aesthetic relief from the pressures and environment of the city.
2. Wildlife habitat is commonly associated with farmland, both game and non-game animals which might not be sustained without the presence of farmland.
3. Recreation provided by farmland varies. There is some public access to these lands, but in general farmers tend to limit the recreational use of their land.
4. Watershed protection is a highly valuable open space attribute of farming in many metropolitan areas. These open spaces intercept precipitation and transfer it to underground systems.
5. Protection of critical environmental entities such as wetlands and floodplains are an important open space function of farms, these areas are fully protected with little cost to the public.
6. Many areas of scenic or cultural value, such as unique landscape or geologic forms and vistas are preserved through agricultural land use.
7. Farmland serves as a buffer between expanding jurisdictions, thereby preventing the spread of the concrete megalopolis.
8. Farmland traps air pollutants such as ozone and sulfur dioxide. Studies show that vegetation is also a very effective filter of particulate matter. Agricultural space also reduces noise pollution, which can be considered another unwanted by-product of our growing urban areas.
9. Open space and preserved farmland serves as a form of landbanking for future options.
10. Open space provides for the recycling of liquid and solid wastes.

There is a critical relationship between open space and the need for cropland preservation. It is important to the survival of farmers as well as farm lands (Lapping, 1979). The farmer's viewpoint reported by Turney (1977) and Berry and others (1976) was that compensation for land owners is required to be fair and to avoid the constitutional issue of taking land without just compensation. Otherwise, certain land owners will absorb losses through reduced freedom of action or lower land prices so that society as a whole might gain.

The provision of open space benefits urban dwellers much more than it benefits farmers. Open space is an urban amenity and farmers should not be expected to bear the loss of their property rights without just compensation. If public policy is aimed at providing this public good for urban dwellers, one of several land owner compensation techniques should be considered (Klein, 1982; Steiner and Theilacker, 1984).

Lapping (1979) cites another major benefit for the protection of agricultural land is to maintain the economic health of local communities. The concept of "critical mass" or the minimum size of the agricultural output and cropland necessary to support required agribusiness firms such as feed mills, processing plants, farm machinery dealers, fertilizer blending plants, and retail suppliers. For example, 74,000 acres was determined to be the critical mass to support a feed mill, and 8,600 acres the critical mass for a fertilizer blending plant (Dhillon and Derr, 1974). If conversion of cropland to other uses reduces the number of acres in production below the critical mass, the local agricultural infrastructure will undergo a change. An important ramification of the "critical mass" concept is that cropland must be preserved as whole areas, not just as random farms (Lapping, 1979).

METHODS OF EVALUATING AGRICULTURAL LAND PRODUCTIVITY

To protect a resource like agricultural land we must be able to do two things: identify the resource and evaluate it. The evaluation processes presented in the following section are primarily concerned with the chemical and physical properties of soil. They are generally accepted and widely used. There are some new methods being adopted by various agencies dealing with soil characteristics as well as man-made factors which affect the agricultural viability of a specific site.

Several organizations and individuals have proposed agricultural land evaluation systems. These systems are based upon a wide variety of factors. Systems of agricultural land evaluation used by most planning agencies are commonly soil productivity rating systems or modifications of these systems. Other methods group soils into broad categories based on productivity (the SCS's "prime" and "unique" farmlands) or rate the individual soils through use of a numerical productivity index such as the Corn Suitability Rating (CSR) system used in Iowa and Illinois (Johannsen and Larsen, 1984).

Soil Capability Classification

There are several methods which may be used to determine soil productivity. The one most commonly used by land use planners is the Soil Conservation Service's Soil Capability Classification System (Figure 2.5).

Soil Classifications. The soils of the United States exhibit a wide range of physical characteristics. Soil types range from the deep loessial (wind-deposited) soils of the Corn Belt, which often have favorable physical characteristics including considerable depth, to the glacial till soils of the Northeast and the North Central region, which often consist of only a few inches of stony, acid topsoil over bedrock or over a dense, crop-limiting soil layer.

The quality of soil resources for agricultural use is commonly expressed in terms of land capability classes and subclasses, which reflect the suitability of soils for most kinds of field crops. Soils are grouped according to their limitations in the production of field crops, the risk of erosion damage they face when they are used for field crops, and the way they are likely to respond to soil conservation treatments.

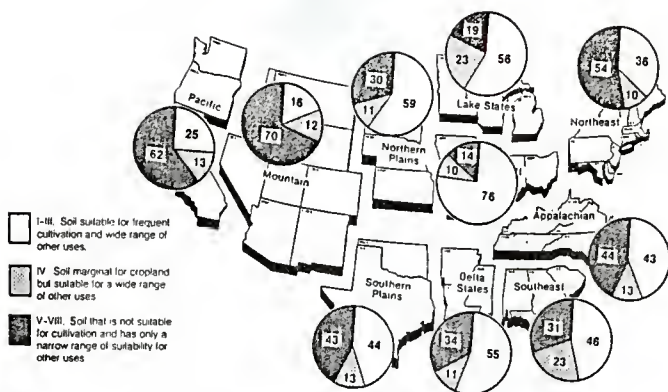
Capability classes, the broadest groups, are designated by roman numerals I through VIII. The numerals denote progressively greater limitations and narrower choices for practical use. The classes are:

- Class I: Soils with few limitations restricting their use.
- Class II: Soils with moderate limitations restricting their use.
- Class III: Soils with severe limitations restricting their use.
- Class IV: Soils with very severe limitations restricting their use.
- Class V: Soils that are not likely to erode but that have other limitations, which are impractical to remove, restricting their use.
- Class VI: Soils with severe limitations that make them generally unsuitable for cultivation.
- Class VII: Soils with very severe limitations that make them unsuitable for cultivation.
- Class VIII: Soils and landforms with limitations that nearly preclude their use for commercial crop production.

Figure 2.5 Capability Classes

(Source: National Agricultural Lands Study, USDA. 1981)

The land capability classification system was set up nearly forty years ago to assist in the planning of cropping patterns and conservation treatments necessary to maintain the productivity of the land without deterioration over a long period of time (Klingebiel and Montgomery, 1961). Eight land capability classes are recognized (Classes I-VIII) (Stallings, 1957). Soils which have the greatest capability for response to management and the least limitations in the ways in which they can be used for agriculture are in Class I. Those with the least capabilities and the greatest limitations are in Class VIII (Buol and others, 1980) (Figure 2.6).



Distribution of Soils by Capability Classes (Percentages) and by Farm Production Regions

Figure 2.6 Distribution of Soils by Capability Classes.
(Source: National Agricultural Lands Study, USDA. 1981.)

The main advantage of this system for land use planning purposes is that information about land capability classes is readily available for most areas of the United States. This system does have some limitations which need to be considered when using it to evaluate lands for protection. The following limitations have been identified: 1.) the soils are not grouped according to their most profitable use; 2.) the system does not provide a reliable rating of soil productivity; 3.) the soil mapping units as they are grouped into a capability class may or may not be more productive than units in another class (Rogers, 1980). In response to these limitations, Eberle (1974) proposed a mapping system which would take into consideration the productivity of soils based on a crop productivity index developed at the University of Illinois.

The SCS system is based on soil characteristics that tend to create risks of damage or limits of productivity, such as slope, stoniness, salinity,

acidity, depth, permeability, water-holding capacity and texture. Raup (1976) neatly summarized the problem of using land capability classes for land use planning purposes when he pointed out that the criteria used to place soils into the eight classifications were designed for use during a period of time when the emphasis was on soil conservation, not preservation of agricultural land resources.

Prime and Unique Lands Inventory

The SCS Prime and Unique Lands Inventory (Johnson, 1975) is closer to a land classification system based on productivity (Appendix B). Under this system, mapping units are classified into one of several categories: 1) Prime Land, 2) Unique Lands, and 3) Lands of statewide or local significance. Prime lands are the most productive. Unique lands are those lands other than prime lands which are scarce and used for the production of specific crops. Lands placed in the third category are of importance to the state or local economy (Johnson, 1975).

Prime land does not correspond to any single SCS land capability class due to the difference in design and intent of the two systems. Generally speaking, the "prime" land category would include all Class I soils, most Class II soils, and some artificially drained Class III soils (Johnson, 1977).

The California Department of Food and Agriculture (1978) recommended that "prime" farmland be defined on the basis of the following: soil productivity, parcel size, number of frost-free days, presence of a buffer zone between agricultural area and urban area, and air and water quality suitable for farming. Evaluation would be on a parcel by parcel basis based on local interpretation of these criteria. The SCS land capability classification system would serve as the main measure of soil productivity. A five-level agricultural land classification system was envisioned, borrowing heavily from

the SCS "Prime-Unique" farmland proposals (see Appendix B for definition of prime farmland). California categories include: prime farmland, unique farmland, unique farmland of statewide significance, farmland of statewide importance, prime rangeland and cropland of local significance not already included in the above categories.

Several inherent problems with the "prime" lands system have already been mentioned. The system does not take into account physical site factors nor does it take into account any economic efficiency criteria. Darling and Eberle have both stated (1984, personal interviews) that soil responds to variables in management techniques which Raup (1976) termed "vertical technology". Vertical technology includes the necessary inputs of fertilizer, water, herbicides and pesticides. Therefore, soil productivity depends on the natural soil characteristics and the level of management applied to the soil by the farmer.

Raup (1976) noted that prime agricultural land is often prime because of its location, rather than its productivity. Land near markets or processing plants could be considered prime regardless of the specific SCS classification. Such lands could be designated as lands of local or state importance. Gibson (1977) considered crop adaptability or the number of crops that a parcel of land is capable of producing as another variable to include in a definition of prime farmland. The crop index used in Illinois is based on a productivity rating of the four major crops (corn, soybeans, oats, wheat) in a standard rotation for various soil groups (Eberle, 1984 personal interview).

The grouping of many different soils into a small number of categories such as "prime" or "unique" reduces the flexibility for future decision making. The time is near when it would become important to determine the relative agricultural importance of soils within the prime or unique categories. The distinction between a soil that barely qualifies as prime and a similar one that does not qualify is made to seem much greater than it really is. A numerical

index that makes use of a 100-point range would eliminate the nebulous connotation of a name or classification system (Wood, 1976).

Storie Index Rating

Storie developed the first numerical rating index for soils in 1937. His system rated land based on productivity data analyzed for several major California soils. The system is comprised of four factors: degree of development, surface texture, slope, and a fourth factor which combined many properties such as fertility, acidity, salinity and erosion. Each factor is then rated, and then multiplied together. The result is the Storie Index Rating (SIR) for that soil type which may range from 0 to 100. Storie advised that the SIR should not be used as the sole criteria for land evaluation. Information should be included on climate, water availability, access to transportation and market proximity (Rogers, 1980; Storie, 1937).

A revised form of the Storie index has been used in New Mexico (LeVee and Dregne, 1951). This modified system resulted in a soil rating which was the product of four factors: soil profile rating, slope rating, erosion rating and a special factor which took salinity, alkalinity, fertility, and acidity into consideration. The main difference between this modified method and the Storie index is that definitive percentages are assigned instead of ranges. Under the Storie system a two percent slope has a rating of 95-100. In the LeVee and Dregne rating the same slope earns a score of exactly 89%. LeVee and Dregne also commented that the growing season and economic conditions should be considered in a comprehensive land evaluation.

Reganold and Singer (1979) reported an interesting comparison study which they conducted in Yolo County, California. In their study, soils in three townships were classed as "prime" if they were: in land capability classes I and II, had a Storie Index rating of 60-100 or if they met the SCS definition of

"prime" farmland. The study concluded that differences in rating effective rooting depth, surface texture, alkali effects, drainage and permeability accounted for most of the variation in the amounts of "prime" farmland identified.

Corn Suitability Rating Index

A different productivity index has been used in Iowa and other midwestern states (with some modifications). This productivity index is called the Corn Suitability Rating index (CSR) (Johannsen and Larsen, 1984). A corn suitability rating for a particular soil mapping unit reflects the effects of many factors which influence crop yields. The penalty applied to each factor varies with its severity. For example, more points are deducted for steeper slopes than for nearly flat ground. The possible range of ratings is from 0 to 100. The highest rating of 100 is reserved for soils located in areas of favorable weather conditions, that have a high yield potential and can be continually row-cropped. A productivity index such as the ones similar to the CSR provide an accurate estimate of the value of a soil by considering both yield potential and the costs of achieving these potentials. The management level or the "vertical technology" should be considered in the development of any productivity indices.

Other Soil-Based Methods

Most of the systems currently used to evaluate the agricultural value of land emphasize soil productivity or the long-term conservation needs of soil. While these factors are important, there are other considerations which should help determine whether a parcel is suitable for conservation.

Wood (1975) called for a system incorporating 15-20 variables resulting in a land rating scale of 0 to 100 points. Some of his proposed factors included:

air quality, crop acceptability, crop exclusiveness, proximity of markets, location of regional processing facilities, pattern of parcel size, adjacent land uses, proximity to urban services, soil productivity and size of the parcel in production. Evaluation of some factors would call for subjective judgements which Wood said would not be a problem. The effect on the total by these factors would be insignificant due to the large number of parameters to be evaluated. The absolute rating would not be as important as the relative position of a parcel of land in comparison to other parcels.

Shirack (1978) presented a list of factors that affect farmland value from an economic standpoint, rather than a productivity standpoint. They include: gross farm income, local population growth rate, occupation of the parcel owner, distance to the nearest urban area, parcel size and value of the farm improvements.

Toner (1978) proposed a generalized formula for communities to use in the identification of agricultural land to be preserved. It states that agricultural land to be preserved equals the total community land minus the sum of all the following: urban lands, lands with poor soils, sensitive lands or lands important for wildlife habitat, land platted for subdivisions, small parcels and odd shaped lots, vacant lands or those not tilled for 3-5 years, lands where no farming investment has been made for five years, developer and speculator owned lands and public open space. This proposal seems to give priority to all other uses over agricultural uses.

Lapping (1979) listed five factors indicating the viability of farmland. They are: 1) SCS land capability class, 2) proximity to markets and agribusiness firms, 3) farm location patterns, 4) level of farm investment, 5) managerial expertise and farmland ownership or tenure pattern. He also noted that the size of the agricultural area and the critical mass are important. This last factor

was part of the reason for the requirement of at least 500-acre areas for inclusion in agricultural districts by New York State (Lapping, 1979).

METHODS OF AGRICULTURAL LAND PROTECTION

Each state has its own unique characteristics including climate, economy, and geography. What preservation techniques which work in New England may not be successful in the Northwest. Any system intended for use throughout the United States must be flexible enough to address local needs. At least 20 million acres of existing farmland or potential cropland is protected through some type of comprehensive state and local programs (Klein, 1982).

One type of protection involves the purchase of farmland development rights. This method is employed by New Jersey, Massachusetts, Connecticut, New Hampshire, Maryland, and in King County, Washington. Agricultural Districting is a preservation tool used in New York and Iowa (Steiner and Theilacker, 1984).

Appendix C identifies state programs for preserving farmland as adopted or expanded upon by state legislatures. Good descriptions of farmland preservation tools and programs have been provided by Steiner and Theilacker (1984), Klein (1982), Fletcher and Little (1982), Batie and Healy (1980), and Woodruff (1980).

One of the first statewide efforts to preserve agricultural land occurred in California in 1965. Under the Land Conservation Act-1965 (also known as the Williamson Act), agricultural land meeting all the criteria set forth in the bill was classified as "prime" (Rogers, 1980). To be designated as "prime" farmland the parcel must meet all of the following criteria (Rogers, 1980):

1. be in SCS capability Class I or II.
2. have a Story Index Rating of 80 to 100.
3. have at least one animal unit month (AUM) per acre annual livestock carrying capacity.
4. be planted in crops, fruits or nuts which have an unprocessed return of at least \$200 per acre during the commercial bearing period.
5. have an annual gross return of at least \$200 per acre from unprocessed plant material during three of the previous five years.

Overtime, there have been some problems with this definition. Most notably, the dollar amounts tacked onto the production levels did not take into consideration the effects of inflation. Secondly, the criteria ignored the question of water availability, much of the land in capability Class I or II cannot be cultivated due to a lack of water (California Department of Food and Agriculture, 1978).

Oregon's statewide planning goal number three (Oregon Land Conservation and Development Commission, 1978) specifies that land in Capability Classes I through IV in western Oregon and I through VI in eastern Oregon be preserved for agriculture. Land within designated urban growth boundaries or that which meets state approved criteria for exceptions is excluded from this requirement. Also to be preserved are additional lands suitable for farm use due to soil fertility, suitability for grazing, climatic conditions, availability of irrigation, existing land use patterns, accepted farming practices, or technological or energy inputs required. This is a Yes/No system which simply asks: "does the land meet these criteria?"

Umatilla County (Oregon) Planning Commission (1977) has used a modification of an approach developed by Rathburn (1976) in Idaho. In this system three priorities are assigned to agricultural land based on the following eleven factors:

1. Land capability classification
2. Size of agricultural area
3. Productive history of the land
4. Availability of irrigation water
5. Proximity to markets
6. Access to transportation routes
7. Climate
8. Proximity of urban areas
9. Unique qualities
10. Approximate average production value per year
11. Percentage of area in non-farm use

The system is designed to be used to rate gross areas of land, not individual parcels, although the latter could be done with some modifications.

Rathburn's (1976) approach creates a very systematic determination of priorities, first by dividing agricultural land into blocks based on several criteria such as land capability classification and cropping patterns, then by gathering information about each of the eleven factors for each block of land. A determination is then made to see if the block of land meets the specific criteria.

Other Agricultural Land Protection Methods

Elsewhere in the United States several local governments are using other approaches to define agricultural land for protection or preservation. One type of protection involves the purchase of development rights to farmland. This method is employed by New Jersey, Massachusetts, Connecticut, New Hampshire, Maryland and Washington. In King County, Washington, criteria have been established for identifying agricultural lands of county significance (Spellman, 1984). They are: parcel size (20 acres or more, 40 if isolated by urban land), SCS Capability Class I, II, III, or some IV, favorable climate, land not committed to urban use, and land not in woodland or swamp.

In Minnesota, the Twin Cities Metropolitan Council (1976) recommended that four categories of agricultural land be identified by participating counties.

The categories include: long-term, short-term, marginal and unique farmland. Criteria used for this identification includes the commercial productivity of the land, cropping history, amount of capital investment, degree of effects from existing or planned urban development, parcel size and ownership patterns. Unique farmlands were determined by special criteria and include peatland farms, orchards and nurseries.

LESA - LAND EVALUATION AND SITE ASSESSMENT

Farmland protection has not been just a state or local issue. At the national level, the Federal government has seen fit to address the loss of prime agricultural land. In 1981, Lloyd Wright of the Soil Conservation Service's Land Use Division in Washington, D.C., was assigned the responsibility for designing a new system to weigh the agricultural suitability of land against demands for other uses (Steiner and Theilacker, 1984).

In recognition of the need for farmland protection, Congress passed the Farmland Protection Policy Act (Public Law 97- 98) in December, 1981 (Appendix A). As part of this federal program to preserve the agricultural land resource, the USDA Soil Conservation Service implimented a system to assist in the evaluation and identification of land that should be retained for agricultural use. This system is known as the Land Evaluation and Site Assessment System or LESA.

The LESA system was developed to assist decision-makers at all levels of government who are responsible for land-use planning. LESA can be used to rate or compare one or more sites for the purpose of determining the specific value that the site(s) may have for agriculture. The Land Evaluation and Site Assessment System can be used to assist in:

1. determining the minimum parcel size for subdivisions in a farming area;
2. planning infrastructure expansion, water and transportation projects, and
3. developing guidelines for conversion of agricultural land to non-agricultural uses.

The LESA system is a tool which can be used to assemble data into a format from which planners and elected officials can gain information upon which to base agricultural values or land-use decisions. LESA utilizes existing and readily available Soil Conservation Service (SCS) information for agricultural land quality evaluations and specific site criteria to supply the data for site assessment.

The LESA system is a two part evaluation system. The Land Evaluation-Part I, is used to rate agricultural land parcels based on soil data. Part II, Site Assessment, is used to analyze a site based on its social and economic viability as farmland.

Land Evaluation - Part I

Land evaluation encompasses four rating systems: 1) land capability classification, 2) important farmlands classification, 3) soil productivity, and 4) soil potential. The Soil Conservation Service (SCS) recommends that one of the last two ratings be used in conjunction with the first two ratings. The land-use division of SCS has published the method to combine these systems in the National Agricultural Land Evaluation and Site Assessment Handbook (USDA, 1983). The handbook summarizes the four systems as follows:

1. Land Capability Classification - identifies for local planners degrees of agricultural limitations that are inherent in the soils of a given area. It enables state and regional planners to use the system for planning and program implementation at regional and state levels.

2. Soil Productivity - relates to the LE score to the local agricultural industry based on productivity of the soils for a specified indicator crop. The use of both soil productivity and land capability classification should provide some indicators as to relative net income expected from each category of soils.
3. Soil Potential - for specified indicator crops are preferred in place of soil productivity in the LE system. Development of soil potential ratings produces classes of soils based on a standard of performance, recognition of the costs of overcoming soil limitations, plus the cost of continuing limitations if any exist. These classes enable planners at the local level to relate to the local agricultural industry.
4. Important Farmland Classification - enables planners to relate to national efforts to protect prime and other important farmland. It enables planners to identify prime and other important farmlands at the local level. Use of the national criteria for definition of prime farmland provides a consistent basis for comparison of local farmland with farmland in other areas.

The Land Evaluation (LE) worksheet will consist of a listing of all soils in the area under analysis. A computer printout of the necessary soil information is available from most Soil Conservation Service state offices. The entry for each soil will show the following information: land capability classification, important farmland class, and productivity index for each soil map unit. If the soil potential index is available it should be used in lieu of the productivity index.

Evaluating a Site For Soil Productivity - The productivity of a soil or soil group should be considered when a decision must be made about the conversion of a site to non-agricultural use or the taking of other action that affects use of the site for agriculture, the relative value of the parcel or site can be determined by local officials. The following procedure should be used to determine the average relative value of the soil on a specific site:

1. Locate the site on a soil survey map and determine the kind of soils which occur on the site.
2. Determine the acreage of each soil on the site and the appropriate agricultural group for each soil.
3. Multiply the number of acres of soils in each agricultural group times the assigned relative value or the adjusted relative value if this method is used.
4. Add the products of the multiplication performed in step #3.
5. Divide the total value obtained in step #4 by the total acreage on the site. The quotient will represent an average relative value for the site.

Table 2.1 illustrates the process:

<u>GROUP</u>	<u>RELATIVE VALUE</u>	<u>ACRES</u>	<u>ACRES x REL. VALUE</u>
1	100	50	5,000
2	80	40	3,200
3	30	10	300
		<hr/>	<hr/>
	TOTAL	100	8,500

AVERAGE SITE VALUE = $8,500/100 = 85$

Table 2.1 - Site soil value calculation

The average site value should only be considered for use on parcels of up to 100 acres or if most of a site is being used for crops. Generally, an average site value should not be used with large sites, because the average value will be greatly affected by a large number of acres of very poor land which has a relative value of 0. When an entire large site is being considered for conservation, however, the average site value must be determined by the above method.

When only part of a large parcel or site is being considered for conversion, the relative value for each soil group on the site should be arrayed for consideration by planners and decision-makers. The areas having low or zero relative values for cropland may have a high relative value for forest land or another use. In terms of cropland protection, however, no efforts should be made to protect areas having low or zero relative values. Planners should always consider the effect of conversion on adjacent agriculture land as well as on nearby properties.

Site Assessment - Part II

The Land Evaluation (LE) value is a good indication of the relative quality of a soil for a particular agricultural use. However, the LE value only considers one aspect of the specific site value to the local agriculture land base. The Land Evaluation score does not take into account the effect of location, distance to market, adjacent land uses, zoning, and other considerations which determine land suitability. In other words, relative soil quality is only one of the many site attributes which may be considered by planners and land-use decision-makers. Consequently, the Soil Conservation Service has incorporated the Site Assessment (SA) segment into the LESA system to account for some of these other attributes.

The Site Assessment portion of LESA provides a system for identifying important factors, other than soils, which affect the economic viability of a site for agriculture use. Each factor selected is stratified into a range of possible values which are in accordance with local concerns, objectives, and policies.

The site assessment (SA) portion of the LESA system is not a mathematically precise exercise. Ward and Grant (1971) describe this weighting procedure as a "linear combination method." Each factor is rated on a separate interval scale.

Then a multiplier, identified as the importance weighting factor, is assigned to each factor. The rating for each factor is multiplied by the weight for each factor.

$$\text{Weighted Average} = \frac{W_1 F_1 + W_2 F_2 + \dots + W_n F_n}{W_1 + W_2 + \dots + W_n}$$

Where F = rating of each individual factor
W = weight of each individual factor
n = number of factors rated

Figure 2.7 - Computing a weighted average

The effect of the multiplication by the weighting factor merely changes the unit of measurement of the rating on each factor by the ratio of the multiplier so that all the ratings are on the same interval scale. The ratings can then be added. With respect to other factors, units of measure for suitability can be made equivalent by rating each factor individually on interval scales with different measurement units. The standard formula for a weighted average is: the sum of the products of the ratings multiplied by the respective weights for each factor, divided by the sum of the weights. Thus, for the purposes of setting up the necessary formulas in the spreadsheet, the sum of these multiplied ratings equal the suitability of the parcel or site for protection or the relative importance in the agricultural land base for the county.

The agricultural economic viability of a site cannot be measured in isolation from the existing and impending land-use needs of the surrounding area. Factors other than the market value of the land for crop production must also be measured.

The Site Assessment portion of LESA is derived from agricultural land use, agricultural viability factors, land-use factors such as regulations and tax

concessions, alternatives to proposed use, impact of proposed use, compatibility with comprehensive development plans, and urban infrastructure.

The following factors have been identified in the LESA Handbook (1983) for use in the site assessment procedure. In the design of the system, any of the factors in the list may be included or deleted as based upon local needs and objectives:

Agricultural Land Use:

- Percentage of area in agricultural use within 1 mile
- Percentage of site farmed in 2 of the last 10 years
- Type of land use adjacent to site

Agricultural Viability Factors:

- Size of the farm
- Land ownership
- Agricultural support system (infrastructure and "critical mass")
- On-site improvements (homes, outbuildings, conservation measures employed)
- Impacts of this conversion on retention of other farmland and the agricultural infrastructure
- Conservation Plan

Land-use Regulations and Tax Concessions:

- Zoning for site
- Zoning for area around site
- Use of agricultural value assessment or other tax benefits
- Agricultural districts or right-to-farm legislation

Alternatives to Proposed Use:

- Unique siting needs for proposed use
- Suitability of site for proposed use
- Availability of less productive lands with similar attributes for proposed use
- Number of undeveloped and suitable alternative sites

Impact of Proposed Use:

- Compatibility of proposed use with existing land use
- Impact on flooding
- Impact on wetlands
- Impact on historical areas
- Impact on recreation and open spaces
- Impact on cultural features
- Impact on unique vegetation

Compatibility with Comprehensive Plan:

Local

Regional

Economical/social importance of the proposed use on the community

Urban Infrastructure:

Distance to urban area

Central water distribution system (within x miles)

Central sanitary sewage treatment (within x miles)

Investment for urban development

Transportation

Distance to job centers, schools, shopping, etc.

Emergency services

(LESA HANDBOOK-USDA/SCS, 1983 pp. 25-27)

The factors suggested in the handbook are general guidelines that should be modified to suit the unique set of land-use values that apply in each community. The criteria to be considered may also vary, but the objective is the same--to guide decision-makers in a comprehensive consideration of land-use issues. The decision should be fair and equitable in the eyes of a majority of the citizens; responsive to local, regional, and perhaps national needs; and within the bounds of legislative and legal authority. Assisting land-use decision-makers in meeting these criteria constitutes a significant contribution to the protection of important agricultural land.

In most areas of the United States the LESA system will be developed at the county level. County governments are usually the level where land-use decisions are made for land (rural/farmland) which lies outside the jurisdiction of cities and towns.

The purpose of site assessment must be determined by the local planning board or commission. The goals and objectives must be clearly defined at the outset. Some of the goals are set forth in the LESA Handbook (1983).

The information used in the development of the site assessment criteria can be assembled from many sources, including: comprehensive plan for a county; various maps such as county road maps; USGS topographic maps and land ownership

maps; current land-use data; land-use regulations and zoning; and field inspection of existing and proposed infrastructure and other public services or utilities.

Factors used by local decision makers should reflect local values and implement local policy. Site assessment factors should assist in the attainment of objectives and previously determined goals. The list of factors is not limited to those used in the example, other factors may be identified and used while others may be deleted.

Combining the Land Evaluation and the Site Assessment

The Land Evaluation (LE) and the Site Assessment (SA) assessment methods were designed to be developed independent of one another. The combined LESA rating gives a better indication of agricultural viability for land-use planning purposes. The pilot study by Steiner and others (1984) demonstrates the procedure for application of the LESA system. For each site, the acreage of each soil unit is multiplied by its relative value (productivity value). The products are the sum of all soil units on the site. The sum is divided by the total acreage of the site to get an average LE rating. The SA score is then doubled, which gives it more importance (weighted) in the combined system. The SA score is then added to the average LE rating. In the counties where attribute scores are weighted, the weighted scores are adjusted so that the maximum SA score is 200. The average LE rating is then added to the SA score. In either case, there is a maximum combined rating of 300. The LESA Handbook (1983) recommends such a 2:1 ratio weighting.

LESA PILOT STUDIES

While various types of agricultural ratings had been developed and used (Rogers, 1980; Tulare County Planning Commission, 1975; Rathburn, 1977), the Soil Conservation Service had not formally designed or tested such a system before LESA. During 1981-83, planners and soil scientists from twelve counties in six states tested the proposed LESA model. The pilot counties were in Florida, Illinois, Maryland, Pennsylvania, Virginia, and Washington.

Two of the pilot counties where the LESA system was first tested were Dekalb County, Illinois, and Whitman County, Washington. In Dekalb County, 97 percent of the land is classified as prime farmland. Not all of this land can be preempted for farmland for reasons previously mentioned. On the other hand only 2.8 percent of the land in Whitman County, Washington, is in the prime category (Dunford and others, 1983). Most of the land in Whitman County is excluded from the prime category because of steep slopes and high erosion potential. Most of the land in the county is under cultivation despite the theoretical potential rating on paper and Whitman County is still the most productive wheat county in the nation.

This pilot program has now been expanded to include all 50 states. As required by the 1981 Farmlands Protection Act LESA is being used to evaluate the impacts of proposed federal projects on farmlands.

LAND USE PLANNING FOR AGRICULTURAL LAND

One of the major concerns which Klein (1982) raised in her bulletin is the amount of natural resource data necessary to effectively implement and manage state agricultural land protection or preservation programs. Most protection laws require, directly or indirectly, large amounts of site data to be gathered for classification purposes. While the problems and situations which relate to

agricultural land protection will vary from state to state, the need for an adequate data base to guide the decision making and problem solving within the program will always remain vital to its success.

A 1976 survey conducted by Miller and Miller presents results which indicate that more than half of the counties surveyed engage in planning activities which include: 1) developing optimal land use plans, 2) compiling natural resource data, 3) developing predictions of land use change, 4) highway planning collection natural resource data, 5) reviewing environmental impact statements, 6) residential and commercial zoning, 7) park planning in rural and urban areas, 8) solid waste disposal, and 9) utilities services planning. At the regional level, planning activities are concerned with land use goals, coordinating land use programs and formulating environmental impact statements.

Factors listed by those counties responding to the survey that were taken into consideration for land use decisions included: 1) soil type, 2) public opinion, 3) legal considerations, 4) population density, 5) slope, 6) available services, 7) hydrology, 8) geology, 9) vegetation type, and 10) social costs versus individual costs and benefits.

INFORMATION SYSTEMS FOR AGRICULTURAL LAND EVALUATION

The LESA System, in concept, is an example of an analysis and inventory system which could easily serve as a model for a computer-based agricultural land information system. With a few modifications to the basic worksheets and the addition of a data base to the model the LESA System could easily provide computer-based analysis and serve as a decision-making tool.

Inventory procedures used by planning and management agencies have typically been developed by concentrating on data which is readily available. A

resource planner or manager must know how management decisions made for his area effect not only his area but the surrounding areas as well.

Geographic Information Systems

One method used to facilitate the evaluation of the large amount of data needed for the evaluation of agricultural land on a local or county-wide basis is the development of a Geographic Information System (GIS) for agricultural land.

A Geographic Information System (GIS) is a computer-aided system designed to store, process, and analyze spatial data. Geographic Information Systems are used for a variety of management and planning purposes including land cover and land use inventories, forest management, wildlife management, agricultural surveys, water resource inventories and management and socioeconomic studies (Pecora VII-Symposium, 1980. Introduction).

Geographic Information Systems (GIS) are similar to other automated information systems (data processing) in that they involve:

1. The collection of data, their transformation into machine readable language (digital form), and their storage and organization within the computer;
2. Editing and updating of the data on file;
3. Manipulation, analysis and retrieval of entire files or selected portions of one or several files by the computer;
4. Generation of a variety of output including maps, charts, and statistical reports;
5. A system to back-up the data stored in the system in case of a malfunction.

The most significant difference between a geographic information system and other classification systems is in the spatial and geographic nature of the data. The data is tied to specific locations on the surface of the earth.

Setting up the geographic-oriented resource data base and information processing system involves four steps: a) data acquisition, b) data management, c) data processing, and d) information display. Data acquisition is the collection and conversion of source data into computer compatible form. Data management defines the logical structure of the data base. It involves entering data into the data base and data base maintenance over time. Data processing is the accessing and manipulation of the data in the data base. Information display is the organization and formatting of the information into documentation (reports, graphs, maps) which will be used by the manager or planner.

Typical data analyses might include the calculation of an area, overlaying and compositing, or the calculation of proximity. These are the manipulations which distinguish a GIS from a computer mapping system (Honeycutt and others, 1980). Using a grid structure, the data is stored in a matrix, the position of which is directly related to the geographic location.

A typical geographic information system might be programmer-, analyst-, or user-operated. A programmer-operated system requires a person trained in the techniques of programming. The interface is nothing more than that provided by the program language and compiler. An analyst-operated system requires the user to have a knowledge of the programs and the end product that the user wants and needs. The analyst can input and format the data to the specifications of the individuals who will be using the information for decision-making. In many cases the analyst is the end-user. The user-oriented system is set up in a manner which allows the planner or manager to sit down at the terminal, receive instructions (prompts) from the program to enter the data and receive satisfactory output.

Output from the GIS takes on many forms: maps, graphs, charts and reports. These output forms can be generated on several devices referred to as

"peripherals." They include: dot-matrix printers, daisywheel printers, ink jet printers, plotters and monitors (monochrome and color).

Maps are the most common form of output generated from a GIS. In the past, the quality of the maps has been marginal to very poor as noted by Honeycutt and others (1980). Today, the quality of maps from many line printers, dot matrix printers and plotters is very legible. Also included in the map output category are the three-dimensional perspective views. Three-dimensional maps are visually impressive and have become popular. Before the computer age, these types of images were time consuming and therefore, expensive to create manually. Now the computer and its associated hardware can generate most three dimensional maps in a matter of a few seconds.

The Role of Computers in Planning

The development of the microcomputer has enabled many planners to utilize the computer as an analysis tool. Prior to the availability of the microcomputer, planners had to rely on organizations which could afford the luxury of a large mainframe computer.

Fifteen years ago mainframe computers dominated the computer field. During the 1970's, the cost of computing dropped dramatically. Twenty years ago the cost of a computer could only be justified by large organizations with the financial resources to support the luxury of a main frame computer. This is no longer true. One result of technological progress has been the introduction of the personal or microcomputer. These smaller, more affordable computers are capable of doing many of the tasks which were performed by their larger predecessors in the 1960's. The microcomputers introduced in the 1970's are appropriate for departments, working groups or individuals within an organization. Technical innovations have made the computer increasingly simple to operate. Little training or technical background is required to become

proficient in their operation (Toong and Gupta, 1982; Poole, 1983). Toong and Gupta (1982) have described the phenomenal growth of microcomputers and their potential in business and scientific applications.

Application programs or software are the tools which determine how effective a microcomputer will be in meeting the users needs. Many of the software packages developed for microcomputers today are very sophisticated and capable of a multitude of applications. Two of the most popular application programs are those dedicated to word-processing and worksheets.

Worksheet or spreadsheet software such as VisiCalc by VisiCorp (1978) and LOTUS 1-2-3 and Symphony by Lotus Development (1983) are examples of electronic worksheets. VisiCalc was the first spreadsheet program for microcomputers. Since its introduction in 1978, it has become the most popular program of all time (LeBlond and Cobb, 1983). Some observers might argue that the spreadsheet programs launched the microcomputer industry. The original version of VisiCalc was written by Daniel Bricklin and Robert Frankston for the Apple II computer developed by Steve Jobs and Steve Wozniak (Golden, 1983). For the first time there was a business application for personal computers in the business world. For about two years the Apple II and VisiCalc ruled the business microcomputer market.

The spreadsheet programs appear on the monitor as a series of rows and columns, similar to an accountant's pad. Because the image on the screen is essentially the same as it is on paper, it is easy for the novice user to grasp the relationships. Once a model spreadsheet is designed, it becomes easy to change and modify the model.

The electronic "pad" on the computer screen is significantly different from the paper pad in several ways. It exists in the dynamic world of the computer memory. The electronic spreadsheets are much larger than their paper

counterparts. Most of the more popular brands have 254 rows and 64 columns. LOTUS 1-2-3 has 2,048 rows and 254 columns (LOTUS Development, 1983).

LOTUS 1-2-3, like VisiCalc is a replacement for the traditional modeling tools: pad, pencil, and calculator. In some ways the spreadsheet software is to the planner what the wordprocessing software is to the typist.

The data-management software programs are a significant improvement over the pad and pencil method of analysis. This form of application software enables the "planner" to evaluate alternative solutions or options in the decision making process by changing the assumptions as often as necessary to quickly answer "what if" questions. In the past, these tasks have been accomplished on large mainframe computers but can now be done more efficiently on the microcomputer for less money and by less technically qualified personnel.

FORECASTING - CAUSE AND EFFECT

"What if...?" - Once the relationships for the model have been defined in the spreadsheet, it can be recalculated with amazing speed, using different assumptions. Changing the model using only pencil, calculator, and paper worksheet would require the user to recalculate these relationships each time a new parameter was considered. If a model has 100 formulas and you change one, you must make 100 calculations by hand to see the effect through the entire model. However, if that same model was on a computer spreadsheet, you would only have to press a few keys to initiate the change. The computer and the program take care of the rest. This capability permits extensive "what if" analysis or comparing different scenarios (Anderson and Cobb, 1984).

For example, suppose the LESA Site Assessment Factor Worksheet user wanted to consider what effect extending the municipal sewer and water system would have on several parcels of prime agricultural land. To forecast the changes by

hand for several parcels might take several hours to reevaluate each site worksheet. Using LOTUS 1-2-3 or another electronic worksheet, all that would be required is a few key strokes to recompute the SA values. The entire process takes only a few seconds per site.

While we could have chosen any microcomputer and compatible spreadsheet software package to complete this study. We chose the IBM personal computer (IBM-PC) and LOTUS 1-2-3 for two reasons: 1) popularity of the IBM and the software designed to operate in the IBM microcomputer, and 2) availability of the software and equipment to the author (Owned by the K.S.U. Department of Landscape Architecture).

CHAPTER III

CASE STUDY FOR EVALUATION OF THE COMPUTER LESA SYSTEM

POTTAWATOMIE COUNTY CASE STUDY

Pottawatomie County, Kansas has a long history of planning oriented public officials. Over the years the county electorate has seen fit to elect people to the county commission who have a good sense of planning for growth management.

According to John Keller and Ray Weisenberger (personal interviews, 1984), two Pottawatomie County planning consultants, there has been a strong desire to structure the county's planning efforts to aid in the allocation of the limited funds to obtain the most benefit from the tax dollar.

There has been an effort to stimulate growth in the county and the emphasis has been on quality not quantity. The completion of the Jeffery Energy Center has increased the county's tax base; almost 70 percent of the tax base is attributed to this one industry. The county commission would like to diversify

the industrial base by inviting small manufacturing and fabrication businesses to the county rather than attracting another large facility like the Energy Center.

Pottawatomie County is by no means experiencing a boom economy or a massive influx of new residents. However, the county commissioners do recognize a need to plan for a future of organized growth. This is apparent in the allocation of the tax contribution from the Energy Center. The commission has seen fit to upgrade schools and existing infrastructure yet still hand deliver license plates to save on postage costs.

Pottawatomie County was chosen for the case study area for several reasons. The primary reason was the long history of planning in the county and the potential for growth into agricultural land. Secondly, the planning consultants for the county are readily available for advise and help in the selection of the sites. This allows for "real" users of the computer-based LESA System to be referenced without any significant cost to the project. The proximity to Manhattan provided easy access to county records and site visitation.

History of Pottawatomie County, Kansas

The following historical account is condensed from an article published in the Westmoreland RECORDER entitled "The Early History of Pottawatomie County" which was written by O.F. "Doc" Maskil (1954).

The Early History of Pottawatomie County

Pottawattomie County was first settled in the 1850's after the Nebraska Land bill made settlement of the new territory legal (see Figure 3.1). Several

men who had driven freight wagons for the government carrying supplies to the newly-established Fort Riley knew that the tall prairie grasses and streams were ideally suited for their livestock.



Figure 3.1 Kansas-Nebraska Territory 1854-1861.
(Source: Socolofsky, 1972)

The Military Road, which followed the Oregon Trail laid out in 1842 by John Fremont, carried as many as 500 wagons per day across the county. The road passed just two miles north of St. George (see Figure 3.2).

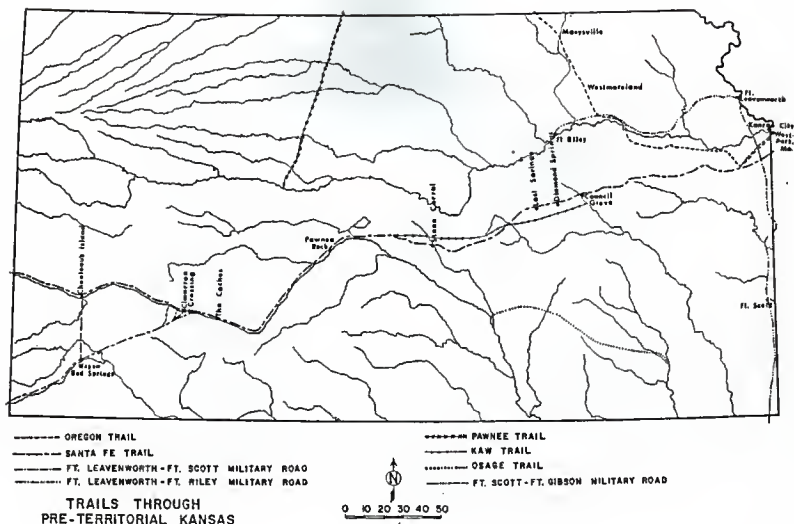


Figure 3.2 Trails Through Pre-territorial Kansas.
(Source: Socolofsky, 1972)

The first counties were established in the new territory in 1855. At this time, nearly all of Pottawatomie County was in Riley County. In 1857 a new county was platted and named after the Pottawatomie Indians. St. George became the county seat where on March 21, 1857, the first board of county commissioners met (Figure 3.3).

In 1861, when Kansas was admitted to the Union, an official county seat had to be voted on. In this election, Louisville was selected and remained the county seat until 1882. In 1882 the county seat was moved to Westmoreland because of its more central location.

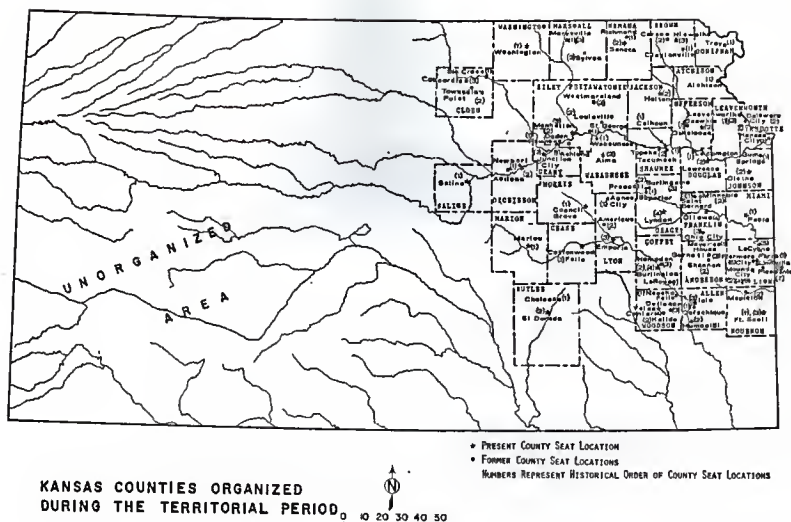


Figure 3.3 Kansas Counties organized during the territorial period.
(Source: Socolofsky, 1972)

During this period Wamego was merely a depot for Louisville which was the central trading post for the county. Wamego is the product of the Kansas Pacific Railroad. The town was first sited in 1855 and was incorporated shortly thereafter. It is the largest community in Pottawatomie County and has experienced steady growth since the 1850's.

Pottawatomie county is located in the northeastern corner of Kansas in the Big Lakes region. It is adjacent to the rural counties of Wabaunsee, Marshall, Jackson and Nemaha, and by the more urban counties of Riley (Manhattan) and Shawnee (Topeka) (see Figure 3.4).

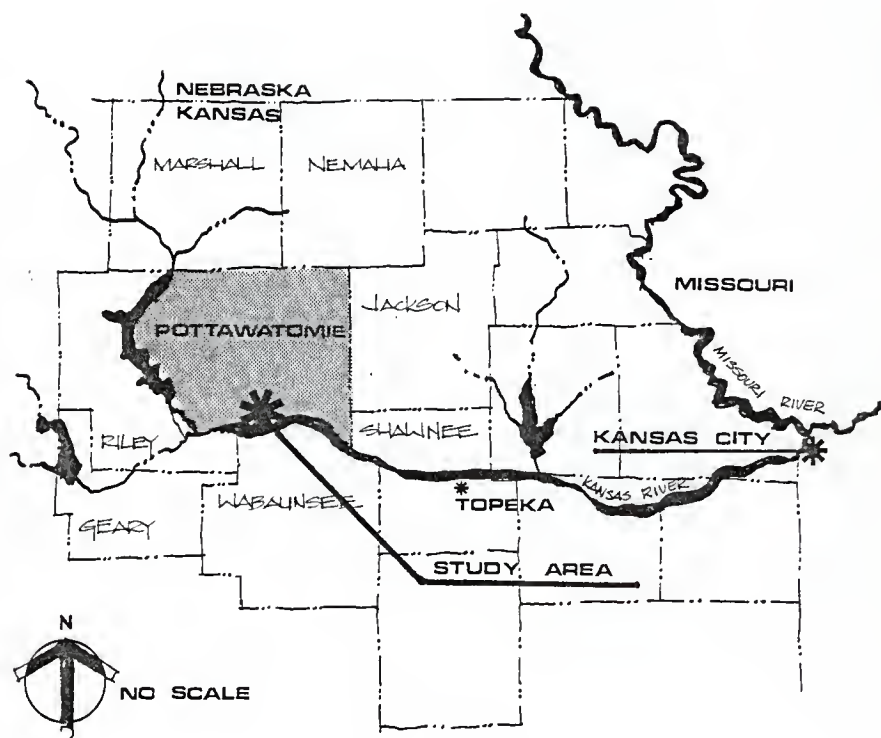


Figure 3.4 Big Lakes region of Northeastern Kansas.

Pottawatomie County has an excellent location in terms of access to regional centers of education, metropolitan areas, cultural and medical facilities, and manufacturing and commercial suppliers. Manhattan, site of Kansas State University, lies partially within Pottawatomie County on the county's western edge. Topeka, the state capital, is located approximately 30 miles east on Highway 24 and Kansas City is 60 miles farther to the east. Most of the development and population pressure occurs along the southern edge of the county which is parallel to the Kansas River and Highway 24 (see Figure 3.5).

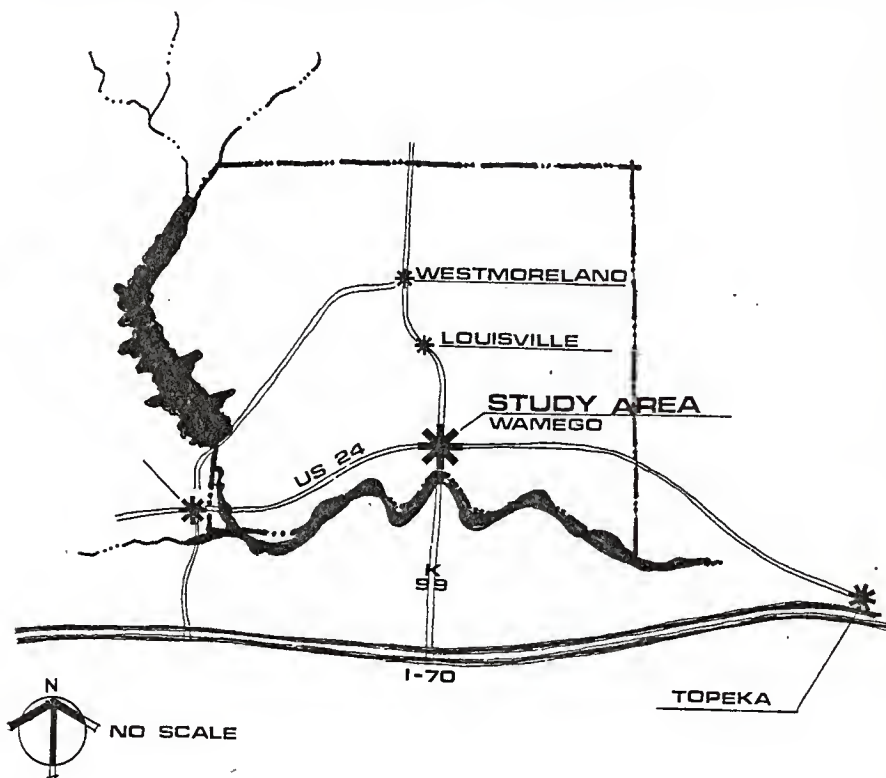


Figure 3.5 Pottawatomie County.
(Source: Pottawatomie Abstract Map, 1984)

Physiographic Setting

Pottawatomie County lies entirely within one major physiographical province, (see Figure 3.6) which is generally hilly and rugged (McCollough, 1974). This region is commonly known as the Flint Hills. However, the southern portion tends to be dominated by wide, low, level areas. The elevation ranges from 1600 feet above sea level to less than 1000 feet along the Kansas and Big Blue Rivers. The area receives a 32-inch average rainfall, 75% of which falls during the 183-day frost-free growing period.

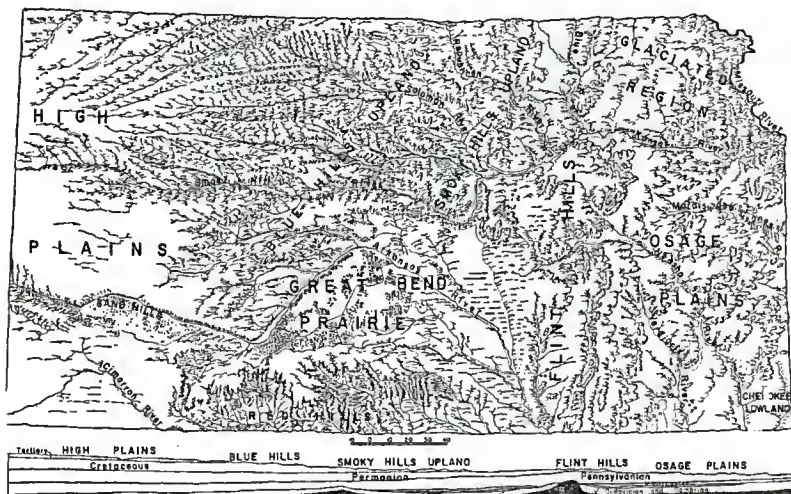


Figure 4.6 Physiography of Kansas-Note Flint Hills Region
(Source: Socolofsky, 1972)

Economic Base - Agriculture in Pottawatomie County

A large agricultural base serves as the primary industry in the county and plays a major economic role. Agriculture accounts for 20 percent of the employment in the county and agricultural related industries and services account for an additional 8 to 9 percent.

The primary crops grown in the county are sorghum, wheat, corn, and soybeans. Of the 524,800 acres occupied by Pottawatomie County, 461,000 acres are classified as farms (Kansas Board of Agriculture, 1981). According to the 1981 figures, 171,420 acres were harvested. Of that figure, 48,400 acres were in sorghum and 28,800 acres in wheat. Corn acreage was reduced by 10,000 acres from the 1971 figures but soybean acreage increased 10,000 acres. It appears that no land was removed from production during this period and there was a shift in crops.

Agricultural land use comprises approximately 82 percent of the acreage in the county. Less than 10 percent of the population owns and farms 99 percent of the land. Agricultural and developed lands when combined total 501,484 acres, the remaining 26,284 acres are classified in various non-use categories (such as rivers, streams, marsh, highways and roads, or small bodies of water). The data for the aforementioned percentages was calculated from aerial photographs, maps, existing land use maps and county records (McCollough, 1974; Kansas Board of Agriculture, 1981).

The total amount of land devoted to agriculture has remained constant over several decades. The development of Tuttle Creek Reservoir (1969) by the U.S. Corps of Engineers has been one of two major changes in the land use scheme of the county. With the exception of Tuttle Creek the majority of the development has tended to take place on open land that is not suitable for agriculture.

The Jeffrey Energy Center (Kansas Power and Light) is the only major non-agricultural industry in Pottawatomie County. It occupies approximately 1,950 acres in the eastern portion of the county. If Pottawatomie County was located closer to the Kansas City or Wichita metropolitan areas, the planning board might be concerned with how much land would be needed to accommodate growth and future development. Since this is not the case, the question here is not one of how much land but where and how growth can be directed for the optimum benefit

to the communities with the least amount of detriment to the agricultural land base. According to the planning commission "[t]here is adequate acreage to accommodate all anticipated residential and commercial growth without reducing productive agricultural sites (McCollough, 1974)."

In the 1974 Land Use Plan (McCollough, 1974), the Planning Commission recommended that the county should adopt a goal of directing growth towards the peripheral of established communities and platted subdivisions rather than filling the perceived voids between communities.

Pottawatomie County Plan For Development

The Pottawatomie County commissioners released the county wide planning goals in May, 1974. These were published in the General Plan for Development of Pottawatomie County--May 1974 (McCollough, 1974). The goals were developed from extensive minutes taken in county planning commission and planning board meetings as well as from input from a variety of sources outside the community.

Pottawatomie County is a member of the Big Lakes Regional Planning Commission. There has been an effort made to coordinate and relate planning activities of Riley, Geary and Pottawatomie County and the city of Manhattan (see Figure 3.7).

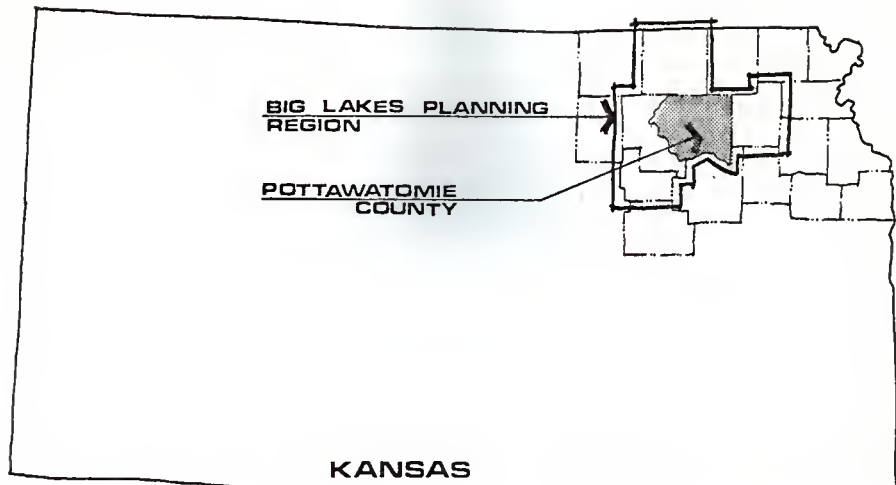


Figure 3.7 Big Lakes Planning Area.

The goals stated in the Pottawatomie Plan (McCollough, 1974) reflect the concerns of the region as well as the county. The goals stated in the plan are as follows:

1. The agricultural resources that have been the basic economic mainstay of Pottawatomie County must be preserved and protected.
 - a. Urban uses must be developed in an orderly concentration to conserve agricultural productivity.
 - b. Urban land uses should be encouraged to locate on marginal and submarginal agricultural lands if these urban uses cannot be accommodated in existing zones.
2. Agricultural related land uses should be accommodated in the county.
 - a. If agriculture is to be accommodated, related uses including implement sales stores and yards, sales barns, feed stores, etc., must also be accommodated.
3. Water resource in Pottawatomie County must be conserved and protected in accordance with specific development proposals.

4. The natural beauty of Pottawatomie County must be preserved for the enjoyment of residents and visitors present and future.
 - a. Pottawatomie County is one of the most scenic, if not the most scenic, county in Kansas.
 - b. The long vistas, rolling topography, and clear streams must be visually accessible to the motorist as well as the hiker.
 - c. Natural cycles and biological balances must be maintained.
5. Development should be prohibited in areas unsuitable for on-site sewage disposal until it is possible or install sewage treatment plants to package units.
6. Industrial development, meeting the highest standards of design and performance that can be assured with existing local, state, and federal regulations should be encouraged in selected locations well served by roads and utilities.

These goals reflect the commissioners' desire to address past, present, and future problems with the process of land changing from rural to "urban" (McCollough, 1974). Most of the land development in the past decade has occurred in the Highway 24 corridor in the southern portion of the county (see Figure 3.5). If the essential agricultural base is to be retained to meet the previously stated goal of preservation of agricultural land, then this corridor of "urbanization" must be approached from the standpoint of urban and rural compatibility.

The potential for a greater degree of urbanization than is already present is quite apparent. This growth could result in the misuse of large areas in the Kansas River Valley. Should this happen, the economic base of the county could be badly eroded.

Zoning for Agricultural Land Use

Most of the goals set by the Pottawatomie County Commission in the comprehensive plan have been implemented in the county zoning ordinances. Appendix D lists the zoning ordinances which effect the use and identification of agricultural land in Pottawatomie county.

POTTAWATOMIE COUNTY SOIL SURVEY DATA

The Soil Conservation Service (SCS) has recently completed the soil mapping for Pottawatomie County. Although the official report will not be published until later in 1985 most of the preliminary data is available through the SCS Manhattan Area Office in Manhattan, Kansas.

To complete this thesis, the author was able to receive a partial copy of the draft report (see Appendix E). The basic soil information was extracted from this document to complete the LESA worksheets and provide the necessary information to substantiate the use of the data.

For classification purposes the county is divided into four broad classifications of soil type and physiography:

1. Kipson-Martin-Sogn Soil Type- this soil type occurs along the entire eastern county boundary near the Blue River and Tuttle Creek.
2. Wymore-Pawnee-Martin Soil Type- is found in a large area of the north and central areas of the county with a small area in the eastern portion as well.
3. Eudora-Reading Soil Type- this soil type is found along the Vermillion River near Westmoreland and along the length of the Kansas River. These soils are usually in bottom lands and prone to flooding.
4. Merrill-Ortello Soil Type- are found in an area generally bounded by St. George, Wamego, Louisville and Flush.

The majority of the soils in Pottawatomie County are Mollisols which tend to be a good soil for crop production but are usually unsuited for engineering purposes (Riley County Soil Survey Report, 1975).

Nearly 80 percent of the land in the county is not suited for septic tank or similar sewage disposal methods. Much of the soil is unsuited for roads and other elements requiring higher engineering classifications of soil.

Pottawatomie County Soil Productivity Rating

The Pottawatomie County Soil Survey, will be the first survey, in Kansas, to be published using soil potential indices. The indices reflect erosion control and other corrective management treatments required to make a specific soil more productive.

The Soil Conservation Service defines the various levels of soil potential as follows:

HIGH POTENTIAL: Production or performance is at or above the level of local standards; costs of measures for overcoming soil limitations are judged locally to be favorable in relation to the expected performance of yields; and soil limitations continuing after corrective measures are installed do not detract appreciably from environmental quality or economic returns.

MEDIUM POTENTIAL: Production or performance is somewhat below local standards; or costs of measures for overcoming soil limitations are high; or soil limitations continuing after corrective measures are installed detract from environmental quality or economic returns.

LOW POTENTIAL: Production or performance is significantly below local standards; or measures required to overcome soil limitations are very costly; or soil limitations continuing after corrective measures are installed detract appreciably from environmental quality or economic returns.

VERY LOW POTENTIAL: Production or performance is much below local standards; or there are severe soil limitations for which economically feasible measures are unavailable; or soil limitations continuing after corrective measures are installed seriously detract from environmental quality or economic returns.

For example, the soil mapping series, Eudora is rated Very High with an index of 99. The management practice prescribed is the use of cover crops. The series Morrill is rated Medium with an index of 64. Management of this soil for optimum productivity calls for the construction of terraces and grassed waterways to control runoff and erosion. The Wamego soil mapping unit is rated Very Low with an index of approximately 24. This soil is generally unsuited to crop production due to shallow soil, steep slopes, susceptibility to erosion, equipment limitations, and maintenance of erosion control systems.

The Rating Index using both a numerical index and a productivity rating classification is unique to the Pottawatomie County soil survey draft. At this time it is not known if only one or both of the options will appear in the final draft.

The index is derived from yield data of the major crops grown in the region. The yield data are the bushels per acre that can be expected under high management for that crop on the specific soil. The crops common to the Pottawatomie County area are grain sorghum, corn, soybeans, and winter wheat. Appendix E contains the preliminary drafts of the Pottawatomie County soil data.

CHAPTER IV

METHODOLOGY

INTRODUCTION

This chapter describes the methodology employed in the adaptation of the Land Evaluation and Site Assessment (LESA) System to the IBM-PC microcomputer and LOTUS 1-2-3 (LOTUS Development, 1983) electronic spreadsheet for the purpose of evaluating agricultural land for protection. The LESA System developed by the Soil Conservation Service (USDA, 1983) will be used as the model for the worksheet design. The worksheet will combine the Land Evaluation, the Site Assessment, a summary sheet, and a soil data base to form an information system for rating agricultural land for the purposes of making planning decisions.

The Shawnee County Site Assessment criteria (see Appendix F) will be used in the design and development of the computer site assessment worksheet. There are several reasons for this selection. Shawnee County is one of only a handful of Kansas counties which have implemented an agricultural land evaluation procedure. The site factors and the weighting criteria were acceptable to

Pottawatomie County Planning Consultant, John Keller. Thus, we did not need to go through the process of determining the appropriate factors for the case study. Development of such criteria is beyond the scope of this project but would be an interesting research topic to explore further. In addition to these considerations, Lonnie Schulze, Soil Conservation Service Conservationist, provided the author with copies of the Shawnee County LESA plan which he helped to implement (personal interviews, 1984).

A brief description of the basic principles used to design and enter the Land EvaluationSA worksheets into a LOTUS 1-2-3 template will be used to introduce the design and layout procedures. The computer worksheets are referred to as "templates" since they can be replicated for each use without redesigning them. The site data entered into the worksheet can be saved in a separate file without "saving" the entire spreadsheet. This is important in reducing errors which can be caused by trying to put too much unnecessary data on a computer disk. The "size" of a file and the problems it can create will be discussed later in Chapter IV.

Once the LESA System is "loaded" in the computer, the Pottawatomie County study sites will be evaluated to analyze the various aspects of the system. The results and discussion of the application are included in Chapter IV as well.

ADAPTING WORKSHEETS TO THE COMPUTER SPREADSHEET

Several considerations were paramount in the initial planning stages of adapting the LESA System worksheets to the microcomputer electronic spreadsheet. Several assumptions had to be made with regard to who the potential users might be. These considerations and assumptions were important in the design and layout process used to develop the templates.

The assumptions made included:

1. the user would be familiar with the LESA concept,
2. the user would be oriented to planning issues and activities either by profession or as an elected official;
3. the user would have at least a limited knowledge of microcomputer operation with regard to entering data through the use of a keyboard.

Based upon these assumptions, the following sub-problems will be addressed in the development of the templates: 1) the ability to provide a simple method for data entry and retrieval, 2) a simple means of output once each worksheet is completed, 3) a menu system to assist the user in moving from one function to another, 4) a demonstration of the versatility of using a spreadsheet to manipulate the LESA worksheets while also providing access to soil information by including a soil data base within the system.

The ability to use an electronic spreadsheet requires no prior knowledge of computer programming. However, some basic experience with a microcomputer and data entry is beneficial to understand the process which is used to guide the user through the program. The labels and figures are entered into the computer in the same manner in which one would enter data on to a paper worksheet through the use of a typewriter, but with the convenience of automatic calculation by the computer. The user can change a worksheet entry and the computer will recalculate the score. The worksheet can be printed as often as needed.

While the use of an electronic spreadsheet is often faster in the long run than the pad and pencil method, a spreadsheet can still be somewhat tedious to set up and use. Labels and numbers must be entered cell by cell. Formulas, which specify specific calculations are often lengthy, confusing and difficult to write. However, once the "template" configuration is completed it is easy to

manipulate and change the data variables. By using some of the special features of LOTUS 1-2-3 to prompt and "lead" the user around the spreadsheet, using the spreadsheet can be a relatively easy task.

The following section includes a brief discussion of the features used to "automate" a spreadsheet and guide the user from one work area to another. This next section is not intended to be a comprehensive lesson in the intricacies of LOTUS 1-2-3, but only a brief discussion of the methods use to accomplish the objectives. For a more complete description of LOTUS 1-2-3 the reader should refer to Using 1-2-3 (LeBlond and Cobb, 1983).

LOTUS 1-2-3 SOFTWARE AND SPECIAL FUNCTIONS

LOTUS 1-2-3, the spreadsheet application program used in this study, is similar to most spreadsheet software. The program allows the user to access a matrix of 2,048 rows and 254 columns. The rows are assigned a number and the columns are designated by a letter. The intersection of the rows and columns are called cells and are identified by a coordinate (i.e. A18 would be the cell address for the intersection of column A and row 18). These cells can be filled with labels, numbers, and formulas or special spreadsheet functions (Figure 4.1)

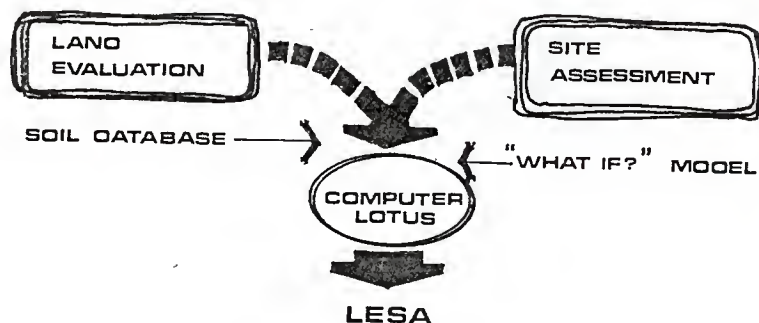


Figure 4.1 Conceptual spreadsheet format.

Cell Relationships and Spreadsheet Functions

Electronic spreadsheets can be set up to allow mathematical relationships to exist between cells. For example, if the user enters the formula $D5=B5+C5$ in cell D5 then regardless of the numerical data entered into B5 or C5 the value in D5 will reflect the sum of those two cells. The formulas can be as simple as the example or more complex. The formulas in a cell can be added, multiplied, subtracted, or divided. In addition to formulas, cells can contain functions (Figure 4.2).

SIMPLE SPREADSHEET

	(Columns)					
	A	B	C	D	...	n
1	TEXT					
2		LABELS				
3						
4		@SUM(B1...B3)				
5			FUNCTIONS			
6						
...				@AVG(D3...D5)		
n						

Figure 4.2 Example of cell formulas and functions.

Functions are shortcuts entered by the user to permit the performance of mathematical computations with a minimum of keystrokes. Functions are like abbreviations for long, cumbersome formulas. LOTUS 1-2-3 provides simple functions (SUM, COUNT, AVERAGE, MAX, MIN, as well as SIN, COS, TAN, and PI).

Macros and Menus

One of the most exciting features of is the ability of the user to program small "user defined" programs. These short programs are referred to as Keyboard Macros. These macros can be used to perform various tasks which are repetitive and tedious or to create sophisticated data input and output. In this case the "user" defining the macros is the designer of the template and not the person ultimately using it to make a LESA application.

A keyboard macro is a series of normal LOTUS 1-2-3 commands, text, or numbers (Figure 4.3) that have been grouped together and given a name. The macro provision in a program provides an alternative to typing commands from the computer's keyboard. The macro is named using a simple one letter code-name. The macro is executed from the keyboard by typing in a simple two key command--ALT key, followed by the letter name of the macro.

```
SOIL MENUMenuJ.1 LE/wrksheet
Enter data into a LE worksheet.
/xlEvaluate site # (Site #J):*CA145*
{goto}
site #6
~
/cCB145*
AR6*
{right}{right}{right}
/xnEnter number of acres for this site:*~
{left}{left}{left}{down}{down}{down}{down}
/xnSelect soil menu # (999 to quit):*AD36*
/xiAD36=999*/xmMenuJ.1*
{query}
/xnEnter number of acres for this soil:*AB36*
/clABELS*~
{down}
```

Figure 4.3 Keyboard Macro-key sequence example.

Using the macro capability, the worksheet designer can automatically perform complex or repetitive tasks with a single key stroke. For example, filling a table with the names of months or consecutive dates could be assigned

to a macro which could be executed to recreate the list when needed. Macros can also be used to automate a worksheet or the entire spreadsheet. The Macro commands can be designed to get data from a data table or accept data entry from the user.

Menus (Figure 4.4) can be created in a macro which look like the standard LOTUS menus. These menus can be used by the user to make choices during the execution of a macro by receiving instructions or warnings during processing and data entry.

```

No Septic No Sewer Yr 2025 Yr 2005 Sewer
Sewer Unavailable; Site unacceptable for septic systems =10 pts
  A B C DE F G H
1 *****KANSAS STATE UNIVERSITY-DEPARTMENT OF LANDSCAPE ARCHITECTURE
2 |=====|
3 | SITE ASSESSMENT WORKSHEET |SITE #1 |
4 | POTTAWATOMIE COUNTY EVALUATION | |
5 | SITE ASSESSMENT FACTORS - PART II | POINT WEIGHTED |
6 | | VALUE VALUE |
7 |=====|
29 | | |
30 | 8. Impact on air quality or noise? | 10 7.68 |
31 | | |
32 | | |
33 | 9. Impact on historical/cultural and | 10 1.92 |
34 | recreational open space? | |
35 | | |
36 |10. Municipal water supply is available. | 10 11.52 |
37 | | |
38 | | |
39 |11. Municipal sewer service is available. | 0 |
40 | | |

```

Figure 4.4 An example of a menu from the Site Assessment Worksheet.

The Land Evaluation and Site Assessment worksheets contained in the Land Evaluation and Site Assessment Spreadsheet are automated by a network of macro commands and menu prompts directing the user to input data from the keyboard.

DESIGNING THE LESA TEMPLATES

There are several basic steps to follow in the development of a complex spreadsheet, especially one such as the LESA System which contains several work areas. The initial concept should be developed on paper. This paper worksheet mock-up makes it easier to layout the various parts since only a small portion of the spreadsheet can be viewed on the computer monitor at any one time. The paper version of the layout can be used to design the "location map" of the various workareas of a large spreadsheet. Figure 4.5 shows the location map for the LOTUS/LESA spreadsheet.

Anderson and Cobb (1984) offer a step by step process to follow when planning and documenting the worksheet. The following tips are presented in

1-2-3 TIPS, TRICKs, and TRAPs (Anderson and Cobb, 1984):

1. When planning a complex worksheet, draw a map showing the layout of the various areas and keep this map updated as you work through the actual template modeling.
2. When building your model, make all your assumptions explicit.
3. Document all your assumptions in one area.
4. Use named ranges in formulas and macros to make worksheets easier to understand. The names should be indicative of the purpose of the worksheet or its location relative to the map.
5. Document all named ranges with comments in the worksheet and in the map. Location by cell address is beneficial in documenting range names.
6. Keep printed copies of formulas, macros, menus, templates and map on hand as the model is developed. Print new copies as necessary when portions are updated.

The first step in designing the spreadsheet layout was done on paper. The approximate location of each worksheet in the LOTUS 1-2-3 matrix was mapped. The relationships between the separate areas was also noted in a schematic diagram (Figure 4.1). This paper layout eventually is used to layout the location map which shows the user the relative location of each worksheet (Figure 4.5).

```

SA/site LE/soil SUMMARY QUIT/save MAN/calc "WHAT IF?"
Choose SA/ site to use the Site Assessment worksheet.
  Q      R      S      T      U      V      W      X      Y      Z      AA
70 =====
71 |***PLEASE CHOOSE A TASK FROM THE MENU ABOVE THIS MAP***|
72 |THIS IS A MAP OF THE SPREADSHEET "AUTO123.WKS"--LESA System. |
73 |=====|
74 |          |          |          |          |          |          |
75 |   SITE ASSESSMENT   |   EVALUATION   |   MACROS   |   LESA   |
76 |   WORK SHEET       |   WORKSHEET    |   (DB1)   |   WEIGHTING |
77 |   (S A)            |   (LE)      |   MENU    |   MODEL    |
78 | (site factors)     |   (soils)   |          |          |
79 |   (A1)             |   (AA1)     |          |          |
80 |=====|
81 | SUMMARY SHEET      |   LAND      |          |          |
82 |          |          |   EVALUATION |          |
83 |   (LE SA)          |   WORK      |          |          |
84 |   (C 70)           |   AREA      |          |          |
85 |=====|
86 |*****|***To escape from MACRO, Press CTRL/BREAK.***|
87 |   MAP OF          |***To restart the MACRO, Press ALT S***|
88 |SPREADSHEET       |<=====You are here|
89 |=====|

```

Figure 4.5 Map of the computer LESA spreadsheet showing relative locations of each work area.

Template One - The Land Evaluation (LE)

The Land Evaluation (LE) worksheet in the computer (Figure 4.6) looks very similar to the model worksheet developed for Shawnee County Land Evaluation and Site Assessment (Shawnee County Planning Commission, 1983) (See Appendix F for details of the Shawnee County site factors).

[illegible]

Figure 4.6 Computer Land Evaluation worksheet.

A Simple Soil Data Base

The major addition to the Land Evaluation portion of the LESA System is the soil data base. Figure 4.7 shows the soil data base for the study site. The menu commands and the macro program prompts the user to enter specific soil information for each site. Upon entering the information requested by the program prompts, the macros take charge of selecting the necessary (pre-determined) data from the data base and places it in the Land Evaluation worksheet for the specific site (i.e., SITE #1).

SOIL DATA BASE POTTAWATOMIE COUNTY, KANSAS

MAP NUM	SYM	SOIL SERIES NAME	PERCENT SLOPE	PRIME/ UNIQUE	PRODUCTIVITY	YIELD RATING	CAPABILITY CLASS
1		Cs CHASE SILTY CLAY LOAM		yes	High	97	11w
2		Em ELMONT SILTY CLAY LOAM	3-7	yes	Medium	58	111a
3		Eu EUDORA SILTY LOAM		yes	Very High	89	1
4		Ex EUDORA KIMO-COMPLEX		yes	Very High	89	11w
5		Ba SYNER SILTY LOAM		yes	Medium	61	111a
6		Mn MAYNIE VEAY FINE SANDY LOAM		yes	Very High	92	11w
7		Ms MAYNIE BARRY COMPLEX			Medium	58	111w
8		Kc KENNEDY SILT LOAM CHANNELED			Low	21	7w
9		Kf KENNEDY SILT LOAM		yes	High	84	11w
10		Ke KING SILTY CLAY LOAM		yes	High	73	11w
11		Mo MORRILL LOAM		yes	Medium	64	111a
12		MT MORRILL LOAM-STONEY LOAM	5-20		Very Low	0	Via
13		Mu MUIR SILT LOAM		yes	Very High	100	1
14		Op ORTELLO FINE SANDY LOAM	3-7	yes	Low	41	111a
15		Or ORTELLO FINE SANDY LOAM	7		Low	25	11a
16		Pe PAMUEE CLAY LOAM	1-3	yes	Medium	60	111a
17		Bq SHARPSBURG SILT LOAM		yes	Medium	60	11a
18		Th THURMAN LOAMY FINE SAND			Low	23	11a
19		Wb WABASH SILTY CLAY		yes	Medium	52	111w
20		Wd WAMEGO LOAM	3-7	yes	Low	44	11a
21		We WAMEGO LOAM	7-20		Very Low	23	Via
22		Wv WINDRE SILTY CLAY LOAM	1-4	yes	Medium	62	111a
23		Ww WYMORE VARIANT, FINE SANDY LOAM	1-3	yes	Medium	56	11a
24		Io IOCK SILTY CLAY LOAM		yes	Medium	57	11a

Criterion Range
NUM NUM SYM SERIES RATING
999 8 Kf 15 54

Figure 4.7 Soil data for the Pottawatomie County study area.
(Source: Pottawatomie County Soil Survey-Draft Report)

The soil data base used in the Land Evaluation worksheet evaluation process is only a partial listing of the soils found in Pottawatomie County. However, it does contain all the information outlined in the specifications for the Land Evaluation section of the LESA Handbook (1983) plus mapping symbols and soil series names as well. Additional information can be added to the data base if necessary. Figure 4.8 shows the soil data base as it appears on the computer monitor. This data base is not viewed during the Land Evaluation (LE) process will be accessed by a LOTUS function command called a Data Query which is included in the macro program.

The soil series map symbols appear at the top of the screen as a menu (Figure 4.8). The menu consists of the soil series map symbol and a digit. The digit is used to identify the specific soil the user wishes to add to the evaluation of a specific parcel.

```

POTTAWATOMIE COUNTY SOIL MAP SYMBOLS MENU
: Ce...1 0a...5 Kf...9 Ma...13 Sa...17 We...21
: Ea...2 Ma...6 Ka...10 Op...14 Th...18 We...22
: Eu...3 Ms...7 Mo...11 Ot...15 Wb...19 We...23
: Ex...4 Kc...8 Mt...12 Pa...16 Wd...20 Zc...24
:
:           Currently Evaluating:  site #6  (Data/soil menu can be expanded to this space.)
:
:
:
:
:
:
=====
:SITE #1  TOTAL ACRES  :    80          :SITE #4  TOTAL ACRES  :   140          :
:=====
:  MAP  MAP  ACRES  PROD  TOTAL WEIGHTED  :  MAP  MAP  ACRES  PROD  TOTAL WEIGHTED  :
:  NUM  SYM  SERIES  RATING  ACRES  INDEX  :  NUM  SYM  SERIES  RATING  ACRES  INDEX  :
:  19  Wb   20      52  25.00%  13.00  :  16  Ps   12      80  7.50%  4.50  :
:  11  Ma   56      64  70.00%  44.00  :  12  Pt   12      0  7.50%  0.00  :
:      0.00%  0.00  :  15  Ot   12      25  7.50%  1.88  :
:      0.00%  0.00  :  11  Ma   56      84  35.00%  22.40  :
:      0.00%  0.00  :  14  Op   28      41  17.50%  7.18  :
:      0.00%  0.00  :  18  Th   16      23  10.00%  2.70  :
:      0.00%  0.00  :  29  Wd   4      44  2.50%  1.10  :
:      0.00%  0.00  :  21  We   20      23  12.50%  2.88  :
:      0.00%  0.00  :      0.00%  0.00  :
:      0.00%  0.00  :      0.00%  0.00  :
:      0.00%  0.00  :      0.00%  0.00  :
:      0.00%  0.00  :      0.00%  0.00  :
:      0.00%  0.00  :      0.00%  0.00  :
:      0.00%  0.00  :      0.00%  0.00  :
:      0.00%  0.00  :      0.00%  0.00  :
:=====
:      (LE) Total for Site # 1 =      57.80  :      (LE) Total for Site # 4 =      42.23  :
:=====

```

Figure 4.8 Land Evaluation Worksheet and Soil Series Menu.

As the user progresses through the Land Evaluation section of the spreadsheet a series of menus and prompts will request the user to enter specific numerical data required to fill out the Land Evaluation worksheet. Figure 4.9 shows an example of the soil series menu and a partial Land Evaluation site worksheet as it appears on the computer monitor. The Data Query function retrieves the required information from the data base and places it in pre-set catagories.

The Data Query function requires that the data exists in a correct matrix format to be accessed by a series of sub-functions called range input, range output, criterion range, and data extract. For a detailed explanation of this process the reader should refer to the LOTUS 1-2-3 user manual (LOTUS Development Corp., 1983).

```

AM14: 'Site #1
LE/wksheet QUIT/LE SAVE/LE REDD/LE PRINT/LE
Enter data into a LE worksheet.
  AL  AM  AN  AO  AP  AQ  AR  AS
1  :POTTAWATOMIE COUNTY SOIL MAP SYMBOLS MENU
2  : Ce...1 Gm...5 Kf...9 Mu...13 So...17 We...21
3  : Em...2 Hn...6 Km...10 Op...14 Th...18 Wn...22
4  : Eu...3 Hs...7 Mo...11 Ot...15 Wb...19 Ws...23
5  : Ex...4 Kc...8 Mt...12 Pe...16 Wd...20 Zc...24
6  :
      Currently Evaluating: 'site #4
      AM  AN  AO  AP  AQ  AR  AS
14 Site #1  TOTAL ACRES :
15 =====
16      MAP  MAP  ACRES  PROD  %TOTAL WEIGHTED
17      NUM  SYM  SERIES  RATING  ACRES  INDEX
18                                     ERR
19                                     ERR
20                                     ERR
21                                     ERR
22                                     ERR
23                                     ERR
24                                     ERR
25                                     ERR
26                                     ERR

```

Figure 4.9 Land Evaluation worksheet as it appears on the monitor.

The cell formulas placed in the Land Evaluation template automatically calculate the values for each column based on the information retrieved from the data base after the Data Query operation. The sum of the productivity ratings is calculated at the bottom of each site worksheet. A cell function that copies the value to the LESA summary sheet.

Template Two - Site Assessment (SA)

The Site Assessment worksheet area of the template is physically larger than the Land Evaluation worksheet area (Figure 4.11). The menus and macro commands to operate the worksheet are more complex and require more room than the menus and macro commands for the Land Evaluation worksheet. This is primarily due to the distinct differences in each of the site evaluation factors. Each factor requires that the user be prompted for an entry which has several options (see Figure 4.11.1). A separate menu (Figure 4.10) will be required to insure that the proper value be selected for each site factor and that the value be placed in the proper cell. The criteria for each site factor and the weighting for each factor can be found in Appendix F.

The formulas which calculate the correct weighted value for each site factor are entered into the appropriate cell. Once the user has selected the desired option from the menu, a series of macro commands enters the appropriate value in one column and the weighted value is calculated and appears in the adjacent cell in the next column to the left. Upon completion of the site factors the weighted values are summed by a pre-set cell formula. A cell function reads the total Site Assessment (SA) value and copies it to the LESA summary sheet.

F9: U
100-90% 89-75% 74-50% 49-25% < 24%
100-90% of land within 1/2 mile is under production = 10 pts.

Figure 4.10 Examples of site factor menus.

*****STATE UNIVERSITY-DEPARTMENT OF LANDSCAPE ARCHITECTURE*****												
LESA WORKSHEET TEMPLATE (THIS IS EXAMPLE-MACROBANK)	SITE #1		SITE #2		SITE #3		SITE #4		SITE #5		SITE #6	
	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	POINT WEIGHTED	
SITE FACTORS FOR ASSESSMENT - PART II	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	VALUE	
1. Percent of agricultural use within 1/2 mile of proposed site?	10	9.87	9	8.721	9	8.814	6	5.814	6	5.874	10	9.87
2. Percent of Land adjacent to site is agriculture?	10	17.28	9	15.552	10	17.28	10	17.28	9	15.552	10	17.28
3. Percent of site is agricultural use?	10	11.52	9	10.268	10	11.52	10	11.52	10	11.52	10	11.52
4. Percent of land zoned agriculture within 1/2 mile?	10	12.44	9	11.096	6	5.264	6	5.064	6	5.196	9	12.76
5. Availability of adequate, appropriately zoned land?	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72
6. Impact of the proposed conversion on the retention of other ag lands?	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68
7. Impact on drainage, floodplains and water quality?	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68
8. Impact on air quality or noise?	5	3.84	5	3.84	5	3.84	5	3.84	5	3.84	5	3.84
9. Impact on historical/cultural and recreational open space?	5	0.96	5	0.96	5	0.96	5	0.96	5	0.96	5	0.96
10. Municipal water supply is available.	9	10.268	9	10.268	9	10.268	9	10.268	9	10.268	9	10.268
11. Municipal sewer service is available.	10	7.68	10	7.68	10	7.68	10	7.68	10	7.68	10	7.68
12. Compatible with comprehensive plan.	5	9.6	5	9.6	5	9.6	5	9.6	5	9.6	5	9.6
13. The site is suitable for the proposed development scheme.	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8
14. Agricultural support systems or infrastructure serve the site.	10	3.84	10	3.84	10	3.84	10	3.84	10	3.84	10	3.84
15. Economic/social importance	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72
16. Location of the site.	10	12.44	10	12.44	5	6.72	5	6.72	10	12.44	10	12.44
17. Transportation to/Accessibility of site	9	8.84	10	9.6	3	2.88	2	2.88	9	8.84	0	0
18. Proximity of Utilities	0	0	0	0	0	0	0	0	0	0	0	0
SITE EVALUATION TOTALS =	120	143,870	120	127,665	109	122,166	109	122,166	110	124,270	118	125,714

Figure 4.11 Site Assessment worksheet.

```

17: J
100-90% 89-75% 74-50% 49-25% < 24%
100-90% of land within 1/2 mile is under production = 10 pts.
      A B C H I J K
1 | ****KANSAS STATE UNIVERSITY-DEPARTMENT OF LAND SCARE ARCHITECTURE
2 | =====
3 | SITE ASSESSMENT WORKSHEET | SITE #2
4 | POTTAWATOMIE COUNTY EVALUATION
5 | SITE ASSESSMENT FACTORS - PART II | POINT WEIGHTED
6 | | VALUE VALUE
7 | =====
9 | 1. Percent of agricultural use | 0
10 | within 1/2 mile of proposed site?
11 |
12 | 2. Percent of land adjacent to site | 0
13 | in agriculture?
14 |
15 | 3. Percent of site in agricultural use? | 0
16 |
17 |
18 | 4. Percent of land zoned agriculture | 0
19 | within 1/2 mile?

```

Figure 4.11.1 The Site Assessment worksheet as it appears on the monitor.

Template Three - The LESA Summary Sheet

The summary sheet (Figure 4.12) is where the Land Evaluation and the Site Assessment scores are summed to get the LESA score for each site. The design of the summary sheet is such that there is no data input requirement from the user. Cell functions and formulas take care of the data retrieval from the Land Evaluation and Site Assessment worksheets. The calculations necessary to get the LESA score. The summary sheet can be accessed for review prior to starting a new site assessment or land evaluation. The summary sheet can also be printed to paper (hardcopy) just as the other portions of the spreadsheet can be.

```

=====
LAND EVALUATION AND SITE ASSESSMENT
SUMMARY SHEET
TEMPLATE III                                     OPTIMUM LESA SCORE = 300
=====
COMPOSITE SCORES SHOWN ARE FROM:      SOILS + SITE      = LESA
=====
POTTAWATOMIE (WAMEGO) SITE #1      66      134      200
POTTAWATOMIE (WAMEGO) SITE #2      65      139      203
POTTAWATOMIE (WAMEGO) SITE #3      73      137      210
POTTAWATOMIE (WAMEGO) SITE #4      61      124      185
POTTAWATOMIE (WAMEGO) SITE #5      69      140      209
POTTAWATOMIE (WAMEGO) SITE #6      54      107      161
=====

```

Figure 4.12 LESA Summary sheet-computer version.

Operator Options Designed into the Macro Commands

The menu and macro operating programs for each of the worksheet areas of the template offer several options to the user. One the most important is the option to send the information seen on the screen to a printer. The print commands, which are a series of keystroke macros, give the operator a printed copy of the site assessment values or the land evaluation values for a site specified by the user.

A second option which can be invoked by the user is the choice to save the values for the site or parcel in a different disk file once LESA is completed or the user may elect to print a hardcopy of the evaluation and quit without saving the values. This option is to enhance the flexibility of the system. If the user is playing "What if..?" (forecasting the effect of different proposals on a site), then the values do not necessarily need to be saved for future reference. However, if a planner is evaluating parcels for another purpose, then the values may be saved if needed for future reference.

A third option designed into the menu and macro commands is the ability for the user to elect to operate the spreadsheet "manually". This means that by selecting the correct menu choice, the macro sequence is by-passed and the user can enter all the values from the computer keyboard in any sequence desired.

In the "manual" mode, the cell formulas and functions still operate to calculate the necessary mathematical operations and place the values in the correct cells. All the user needs to do is enter the desired values. Upon completion of the Site Assessment and Land Evaluation worksheets, the values for each part will be copied to the summary sheet. The LESA value for each site is automatically calculated for review either by viewing on the monitor or a hardcopy printout.

SELECTION OF SITES FOR EVALUATION

The sites to be evaluated by the computer LESA System will be chosen from the area surrounding Wamego as suggested by Pottawatomie County Planning Consultant, John Keller. As explained earlier the sites or parcels are tax parcels. Within the study area there are 61 different tax parcels. Of these, 14 are already developed for housing, commercial or other nonagricultural use. The parcels in nonagricultural land use will be excluded from the selection and evaluation process. Location of each parcel and the boundary established by Keller is shown on the land ownership map of Pottawatomie County available from the Pottawatomie County Abstracters' Office in Westmoreland, Kansas. Figure 4.13 illustrates the location of the tax parcels within the study area.

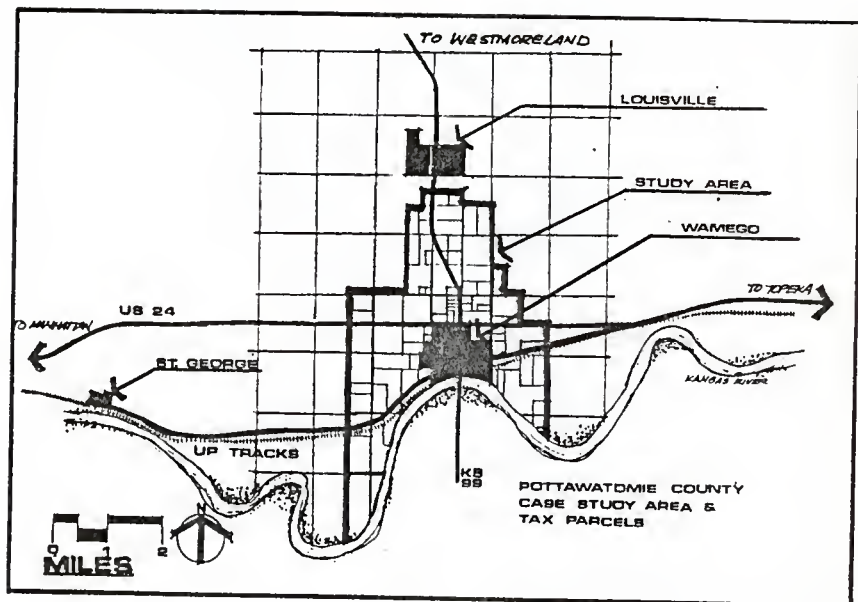


Figure 4.13 Tax parcels by ownership - Pottawatomie County.
(Adapted from the Pottawatomie County Abstract Map, 1984)

To expedite the evaluation process, only a portion of the 61 tax parcels will be selected for LESA evaluation. The following steps will be taken to identify the sites to be evaluated:

1. Each parcel shown on the ownership map will be assigned an identification number.
2. The number of sites to be evaluated will be determined by using the random number generating program available for the IBM-PC (Poole, 1983).
3. After the number of sites is determined, a second set of numbers will be generated by the computer. These numbers will be the sites from which the data will be collected from to evaluate the computer Land Evaluation.
4. An analysis of each parcel will be completed to determine:
 - a. the number of acres in each parcel
 - b. soil types located on each specific site
 - c. the number of acres for each soil type on the site
 - d. proximity of electric utility service
 - e. proximity of site to roads and railroads
 - f. current land use of each parcel
 - g. current land use of adjacent parcels
 - h. surrounding land use (within 1.5 miles)
 - i. proximity to town and municipal utilities
 - j. current zoning of site, adjacent parcels and surrounding land
5. The information requirements outlined in the Land Evaluation methodology will be met partially through data collected during this phase and through soil data already collected to design and develop the soil data base described previously.

6. Additional information necessary in completing the Site Assessment worksheet will also be collected at this time (reader is referred to the Site Assessment Figure 5.12). Other data such as the type of project proposed and the economic and social importance of the project, that in a real life application of the LESA System, would be information which is fact and available to the individual doing the data entry. In the hypothetical case study, a small manufacturing plant will be the proposed project. The proposed project meets all the county commission's requirements and guidelines. There will be little noise, air or water pollution. The project will not effect any watershed nor will it be allowed to be built in the 100-year Kansas River flood plain.

The above information will be taken from various sources including : site visitation, the "advanced copy" soil survey maps of Pottawatomie County, USGS topographic maps, aerial photos, county road maps, zoning and land use maps of the county, and information supplied to the author by Pottawatomie County Planning Consultant, John Keller. Figure 4.14 shows some of the information necessary to complete a site analysis and the sources (Rogers, 1980).

Upon completion of the data collection, each of the selected sites will be evaluated using the LESA System adapted to the LOTUS 1-2-3 spreadsheet program and the IBM-PC microcomputer. The results of the evaluation will be presented in the following chapter along with a discussion of the application procedures.

Before beginning the evaluation process, as much of the following information as possible should be assembled. An on-site visit may be required to assess certain conditions such as surrounding land use and soil drainage improvements.

<u>Information</u>	<u>Sources</u>
1. Plat map of subject property showing size of area and surrounding parcels	1. County Assessor's office
2. Soil map of subject property with corresponding legend	2. Published Soil Surveys- maps on file in SCS office
3. Tables of predicted yields for all soil map units in county	3. Published Soil Surveys- unpublished data on file in local SCS offices. Data from same or similar soils in nearby counties
4. Data on acreages and cash receipts generated by main crops in county	4. County Extension Agent
5. Availability of irrigation water	5. Farmer/landowners and long-time residents of the area - Geology, Hydrology studies - Water-Masters of Irrigation Districts
6. Drainage class of soils in subject property	6. Published Soil Surveys - OR-1's - Local SCS or Extension offices
7. Status of artificial drainage improvements	7. Farmer/landowner - ASCS office - SCS office
8. Nature of land use of adjoining parcels, e.g. rural residential, commercial, forestry, etc.	8. Farmer/landowner On-site inspection
9. Location of nearest Urban Growth Boundary for cities over 2,500 population	9. County Planning Office

Figure 4.14 Information required to utilize an agricultural land evaluation model.

(Source: Rogers, 1980 p. 27)

CHAPTER V

RESULTS AND DISCUSSION

RESULTS OF THE LESA EVALUATION OF THE CASE STUDY SITES

In the proceeding chapter, the steps taken in the collection of data to initiate the LESA evaluation were outlined. The following sections will be used to present the results of the LESA System evaluation of the Pottawatomie County sites. A discussion of conclusions and areas for further study will be included to summarize the process and the findings of the study.

Results of the Computer LESA Site Evaluations

The random number generating program was used to select the number of Pottawatomie County sites to be evaluated by the LOTUS/LESA Agricultural Land Evaluation and Site Assessment Information System. The procedure outlined in

the previous chapter was then followed in collecting the necessary data to evaluate the sites.

The first number generated by the computer was 13. This meant that of the 47 agricultural tax parcels in the study area, 13 would be chosen for evaluation. The next numbers generated by the computer were:

2, 7, 12, 14, 23, 27, 29, 34, 37, 39, 41, 44, and 46.

These numbers represent the Pottawatomie County sites to be evaluated. Figure 5.1 shows the location of these sites within the study area. As illustrated by the map, the sites selected by the random number procedure are a fairly representative sample of the various types of topography, soil conditions and location relative to Wamego.

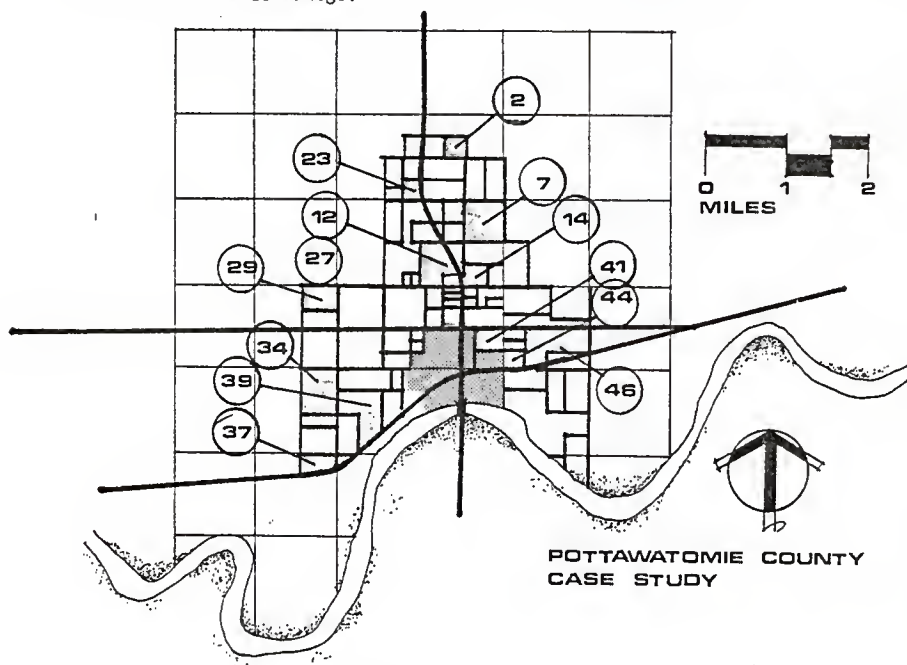


Figure 5.1 Location of 13 Pottawatomie County sites.
(Source: Pottawatomie County Abstract Map, 1984)

Appendix G contains the field worksheets for each of the sites. These paper worksheets show the data entered into the electronic spreadsheet to calculate the Land Evaluation (LE) score. These worksheets also indicate pertinent information on location of roads, utilities, adjacent and surrounding land use as well as the location of electrical utilities and the proximity to Wamego.

Land Evaluation Using the LOTUS/LESA Worksheet

The soil data required to complete the soil evaluation using the Land Evaluation worksheet was gathered from the advance copy of the soil series maps. To simplify the calculation of acreage, the total acreage for each site or parcel was determined using a grid/dot area estimating tool (Figure 5.2). This tool is not quite as accurate in measuring area as a planimeter but it is faster and easier to use.

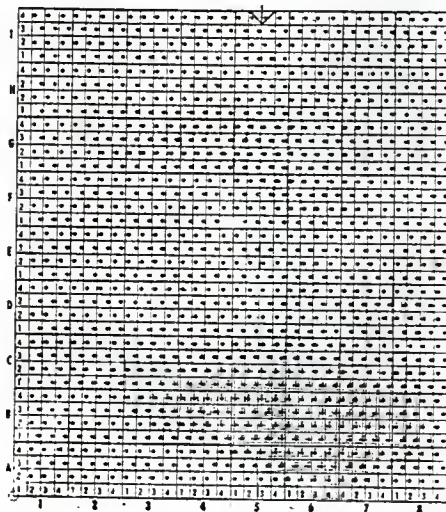


Figure 5.2 Grid/Dot area estimating tool (not to scale).
(Source: USDA-Forest Service Item number: 45026)

The grid/dot method was chosen in keeping with the lay-planner/decision-maker as a potential user of the computer LESA System. The precision achieved with a planimeter is not justified in calculating the acreages for this evaluation is at this level of analysis for decision-making purposes. The expertise necessary to utilize a planimeter and the degree of accuracy of the planimeter readings is out of context with the intended use of the LESA/LOTUS tool.

<u>Site</u>	<u>Map #</u>	<u>SA Score</u>
Site 1	#2	134
Site 2	#7	138
Site 3	#12	137
Site 4	#14	124
Site 5	#23	140
Site 6	#27	107
Site 7	#29	144
Site 8	#34	140
Site 9	#37	122
Site 10	#39	122
Site 11	#41	124
Site 12	#44	134
Site 13	#46	122

Table 5.1 Land Evaluation Scores for the 13 tax parcels.

The Land Evaluation results for each site are illustrated in Table 5.1. The Land Evaluation scores for the thirteen tax parcels ranged from 28 to 94. The maximum or theoretical optimum Land Evaluation score for any site is 100.

Site Assessment Using the LOTUS/LESA Worksheet

As explained in Chapter IV, all sites zoned or developed for nonagricultural use were excluded from the evaluation. The areas zoned to nonagricultural use are delineated in Figure 5.3. Figure 5.4 shows the location of all major roads, and watercourses.

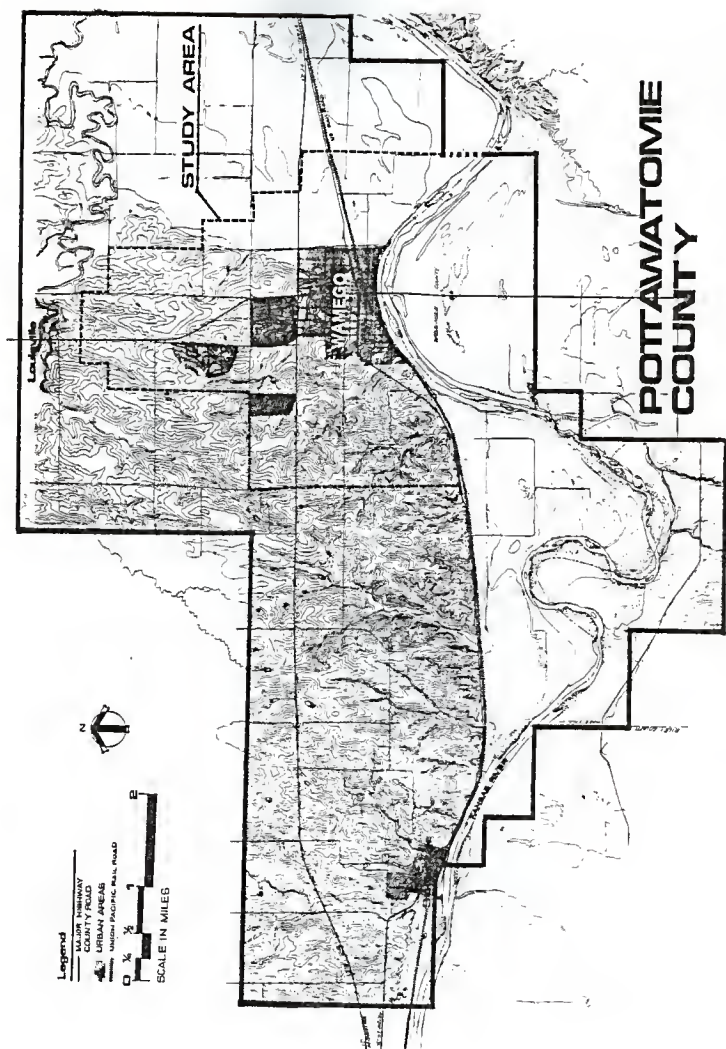


Figure 5.3 Pottawatomie County study area topography and urban areas.

(Source: USGS Wamego quadrangle, 1978)

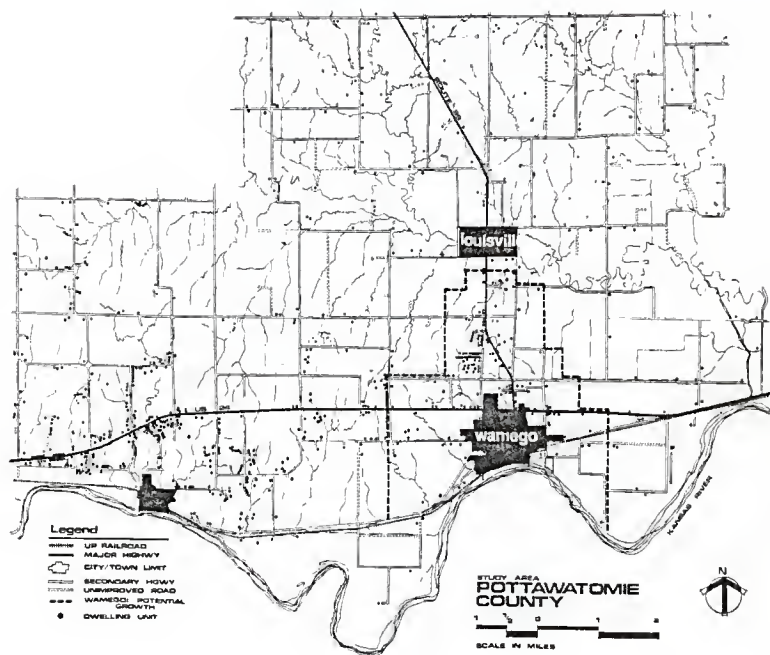


Figure 5.4 Study area map showing major roads and dwelling units outside the corporate limits of Wamego.
(Source: Pottawatomie County Abstract Map, 1984)

For purposes of this study, the land outside the corporate limits of Wamego is zoned agriculture unless it is currently developed for housing, industrial (such as gravel mining), or commercial (such as meat packing or agribusiness).

The results of the Site Assessment (SA) evaluation of the thirteen sites is shown in Table 5.2. The Site Assessment scores for the thirteen sites ranged from a low of 107 to a high of 144. The maximum Site Assessment score for the best agricultural land is 200.

A combined Land Evaluation and Site Assessment score of .300 is the theoretical optimum score for agricultural land deserving protection under the SCS LESA guidelines. The Summary Sheets in Figure 6.5 shows the LESA scores for the thirteen sites. The LESA scores range from 152 for Site #41 (#11 in the evaluation) to 228 for Site #44. (#12 in the evaluation) (Table 5.3).

<u>Site</u>	<u>Map #</u>	<u>LE Score</u>
Site 1	#2	66
Site 2	#7	65
Site 3	#12	73
Site 4	#14	61
Site 5	#23	69
Site 6	#27	54
Site 7	#29	58
Site 8	#34	33
Site 9	#37	33
Site 10	#39	42
Site 11	#41	28
Site 12	#44	94
Site 13	#46	94

Table 5.2 Site Assessment Scores for 13 tax parcels.

<u>Site</u>	<u>Map #</u>	<u>LESA Score</u>
Site 1	#2	200
Site 2	#7	203
Site 3	#12	210
Site 4	#14	185
Site 5	#23	209
Site 6	#27	161
Site 7	#29	202
Site 8	#34	173
Site 9	#37	155
Site 10	#39	164
Site 11	#41	152
Site 12	#44	228
Site 13	#46	216

Table 5.3 Results of the LESA Evaluation of the study area parcels.

Decision Making Based on the LESA Scores

Once the LESA evaluation has been completed for several parcels a decision must be made as to the relative economic value of each parcel to the agricultural community. The LESA Handbook (1983 p. 25-27) recommends that the following criteria be used to rank parcels.

By adding the Land Evaluation score to the Site Assessment score, the total LESA score for each parcel can be determined. The maximum total score for any given site is 300. The LESA score indicates the relative economic viability for protection purposes.

>250 Points: sites scoring in this range should receive strong consideration for preservation.

225 - 249 Points: sites which fall in this range should receive high protection efforts.

200 - 224 Points: the sites scoring in this range should get moderate protection efforts.

<200 Points: sites scoring below 200 points should receive low protection efforts.

Based on these rating criteria the 13 sites evaluated rate from low to high. Six of the sites are categorized as low priority, six rated moderate and only one rated in the high range. Table 5.4 illustrates the ranking using the above criteria.

<u>Site</u>	<u>Map #</u>	<u>Protection Rating</u>
Site 1	#2	Moderate
Site 2	#7	Moderate
Site 3	#12	Moderate
Site 4	#14	Low
Site 5	#23	Moderate
Site 6	#27	Low
Site 7	#29	Moderate
Site 8	#34	Low
Site 9	#37	Low
Site 10	#39	Low
Site 11	#41	Low
Site 12	#44	High
Site 13	#46	Moderate

Table 5.4 Site rankings by LESA scores.

Discussion - LOTUS/Land Evaluation Worksheet

The Land Evaluation portion of the LOTUS worksheet is a straight-forward, objective analysis of data which can be easily extracted from sources readily available to any land-use planner or decision-maker. The data is in a numerical form which makes it easy to manipulate using simple mathematical relationships. The quantitative nature of the data makes this part of the LESA System the least complex worksheet template.

The addition of the soil data base and the short menu and macro commands which operate the Land Evaluation worksheet makes the LOTUS version a neat package for soil productivity analysis. To make the data quantitative, the soil potential and productivity indices need to be expressed in numerical values. If the SCS chooses to express these parameters in word form (such as Very High,

Medium, or Low), there will have to be a range of numeric values associated with the descriptors to allow mathematical manipulation to determine a score.

Discussion - LOTUS/Site Assessment Worksheet

The Site Assessment worksheet template occupies over two-thirds of the total spreadsheet area. The space necessary to accommodate the worksheet was the overriding factor in the final spreadsheet layout. The macros and menus which operate the Site Assessment worksheet occupy over 90 percent of the worksheet area designated for macros and menus. A little less than one half of the total spreadsheet area is occupied by the menus and macro commands.

The judgemental quality of many of the Site Assessment factors will tend to exhibit the expressed values of the criteria used to determine the Site Assessment scores. It appears that some of the 18 site factors included in the Shawnee County LESA (which was used as the model for this project) tend to aim the Site Assessment results in favor of development. Factors such as the "Compatibility with the county comprehensive plan."; or "The economic/social importance of the proposed project.", appear to drop the overall high marks of what appear to be sites which should score higher Site Assessment scores. If the County Comprehensive Plan favored production in agricultural areas, an agricultural site could be compatible without necessarily promoting non-agricultural development. This is an area which needs further study.

The political emphasis toward protection of farmland or development may be seen in the type of factors included in the Site Assessment criteria. The Shawnee County example has, what appears to be an equal proportion of pro-agricultural land protection and pro-development parameters. It would be of interest to evaluate enough sites to apply some statistical analysis techniques such as the analysis of variance and distribution analysis to the Site

Assessment and LESA scores. A possible extension of this thesis would be to use this computer-LESA System and evaluate a significant number of sites and perform the appropriate statistical analysis.

Design and Development of the LESA/Lotus System

During the course of the past two semesters, the format of the worksheets in the computer have taken many shapes. Approximately 115 hours of logged computer time was spent in the design and development of the LESA templates. This does not include the many hours of frustrating salvage after an operator's error erased portions of the worksheet, nor does it include time spent correcting errors during program presentations to committee members and faculty.

Approximately 15 hours of design time was spent on the schematic layout of the worksheet and development of the menu and macro sequence. Approximately one-third of the computer time logged was spent in trial-and-error testing of several template layouts.

An additional one-third or 35 hours was spent in developing the macros and menu operating sequence to perform in the desired manner. Sixteen hours (to date) have been spent enhancing the "Gee whiz" components of the macros. While some of the "Gee whiz!" aspects which are a more technical, higher level operating aspects of the macro/menu operations are not necessary to operate the worksheets, they add to the convenience and the flexibility. These enhancements also add to the intricacy of the spreadsheet and make it more difficult to trouble-shoot. It should be noted that prior to undertaking this project the author had written only a short three line keyboard macro and had no experience in the use of menus. A similar project would take less time to implement once the basic layout and relationships were established.

The LOTUS 1-2-3 manual (LOTUS Development, 1983); TIPS, TRICKS, AND TRAPS (LeBlond and Cobb, 1984), and USING LOTUS 1-2-3 (LeBlond and Cobb, 1983) were

extremely helpful in learning the ins and outs of using keyboard macros and menus to manipulate the data and move around a spreadsheet.

The task of developing a nonfinancial application for the LOTUS spreadsheet was a hinderance in the beginning. The majority of articles published in computer periodicals are aimed directly at the accounting and financial users of software such as VisiCalc (VisiCorp, 1978) and LOTUS 1-2-3 or Symphony (LOTUS Development, 1983). Even though these programs were written to meet the needs of those individuals wanting financial modeling tools, the only limit is the designer's imagination and a project or task that requires the manipulation of numbers. Some possible applications will be discussed later.

As the development of the templates progressed from designing on paper to entering them into the computer, it became apparent that the system was going to be more complex than initially thought. To make the computer LESA as easy to use as possible meant that a large portion of the work area would have to be dedicated to the menus and keyboard macros. Most of the first-time users were excited by the "technology" and the speed at which the computer manipulates the data. A rather interesting phenomena can be witnessed when demonstrating the abilities of the computer. Charles Killpack, (1982) referred to this reaction as "pinballism", the ability of the "player" to operate the flippers without understanding the game. The professional quality of the finished product can easily mask any errors buried in the unseen operating programs and data bases.

Based on the above observations, it is important that the reader and potential users of the LESA/LOTUS spreadsheet (or any other similar application) understand that the spreadsheet is only a tool to assist in the decision-making process. The power of a computer to get work done faster also creates the opportunity to make more mistakes and multiply them rapidly. A spreadsheet model designed by one person can be extremely difficult for another person to understand, use, or revise. There are some precautions which should be taken

when preparing a spreadsheet template for distribution to other users. This is especially true if a spreadsheet designed by one person might be adapted to a similar use by another without fully understanding the structure of the model. In many instances a user may be better off trying to develop their own template from scratch. It takes a considerable effort to understand the original designers intentions before any revisions can be made. In most cases people spend more time retrofitting another persons template than they might have in developing their own.

Grushcow (1985) suggests ten steps to follow in the development of a spreadsheet to help prevent "spreadsheet disasters."

Don't start without a plan. Plan your spreadsheet starting with a list of objectives.

Use the cell protect feature. Using this feature means the same spreadsheet can be used reliably again and again by the designer and others.

Don't mingle data entry areas with calculations. If the designer can turn on the protection feature, someone else can turn it off. Keeping the formulas separate from those areas where data is being entered will reduce the possibility of overwriting an important cell function or formula.

Make your data input resemble existing forms. When designing a spreadsheet that automates a task, design the data entry area to resemble the original paper forms as closely as possible. By keeping forms consistent, the designer can avoid errors caused when the user encounters an unfamiliar layout. Also, using this concept is an easy way to introduce new users to spreadsheets. The form gives the computer a friendly face.

Use the input area as a data capture form. When a spreadsheet has a separate data input area, that section of the spreadsheet can be printed. The printout of the form can be used to format the data into correct format, improving the accuracy of data entry.

Enter data in either columns or rows, not both. Entering data in a consistent direction allows the user to concentrate on the data entry and not the manipulation of the cursor.

Use manual calculation when entering data into a large spreadsheet. By setting the spreadsheet to manual calculation the data entry can proceed much faster. Be sure to turn the recalculation feature back on.

Place instructions and identification in the spreadsheet. A separate area should be set aside for the following information:

- 1) the spreadsheet designer, 2) date of design,
- 3) file name, 4) date last used and date last audited

Back up your files. Be sure that a back up copy exists in more than one location. Loss of a large spreadsheet could be costly in man hours lost both to reproduce the template and productivity.

Always test your spreadsheet. When building a model or using an unfamiliar template always test the calculations manually. When possible, check your results against results that are known to be correct.

In addition to the ten cautions listed above, it is essential to document the spreadsheet. Documentation should be entered into the spreadsheet format. This precaution will assist in "debugging" the spreadsheet in the event changes need to be made at a later date. Documenting a spreadsheet with a manual should be a standard practice of any individual who designs spreadsheets for use by others. The manual can act as a tutor as well as explain the idiosyncrasies of the worksheet. The manual and documentation for the LESA/LOTUS spreadsheet can be found in Appendix I.

Basic Assumptions in the Template Design and Layout

Even though one of the goals was to make the computer LESA System as easy to operate as feasible using the microcomputer, it is still important that the user be familiar with the operation of a computer. There are still situations which arise while using the macros to manipulate data and move around the

spreadsheet which are impossible to predict and design a series of keystrokes to recover an errant command from the keyboard. The LESA spreadsheet design is not fool-proof; even with the proper documentation there should be someone available who is knowledgeable of the basic LOTUS operations and commands in case of a malfunction. A immeasurable amount of time could be spent perfecting the intricacies of macro commands to cover all the variables.

Limitations

During the development of the LESA templates several limitations were discovered. Even though the LOTUS 1-2-3 spreadsheet is 240 columns wide and 1040 rows long, most microcomputers do not have sufficient Random Access Memory (RAM) to access a worksheet or template of that size. The average IBM-PC and compatible microcomputers of today have only 256 KB (kilobytes) of RAM. This "small" amount of access memory proved to be a limiting factor in the number of Site Assessment worksheet columns and the number of Land Evaluation worksheet areas that could be placed in a spreadsheet.

The spreadsheet as it stands now, contains only six replications of each of the Site Assessment and Land Evaluation worksheets. When the number of worksheets in the two sections was expanded to do twelve sites prior to saving the data and starting over, the computer would return a "memory full" error message. The spreadsheet to evaluate twelve sites was a "monster" template which required all the remaining RAM memory (not used by LOTUS 1-2-3) just to be loaded into the computer memory. No data could be entered or manipulated. Consequently, the number of worksheets was reduced to a more manageable number. Only six work areas are used in the final LESA spreadsheet template. To evaluate more than six sites, the planner will need to recall the template as many times as necessary to evaluate all the sites.

A second element limited by the memory is the size of the soil data base which can be included in the spreadsheet. The soil data included in the model of the LESA template was only a portion of the soil data necessary to do a LESA evaluation of an entire county. The data in the model was for only 24 of the 43 soils found in Pottawatomie County. Other counties in Kansas have as many as 60 to 100 different soil series. Shawnee County which was used as the existing Kansas model for LESA, has 67 different soils. The number of soils to be included in the data base would be a restriction on the number of worksheets that could be accessed between each time before the site data needed to be "saved" to another file.

Throughout the design and development of the computer LESA System, several different computers were utilized. The majority of the development was completed on an IBM-XT which has a ten megabyte harddisk. In addition to the XT an IBM-PC with two floppy disk drives and a ZENITH 150 (IBM compatible) with a ten megabyte hard disk were also used. The two computers with the hard disks were faster in response time as the spreadsheet reached its ultimate size. The difference in real time to the user is almost negligible, however.

ADDITIONAL CONSIDERATIONS AND FURTHER STUDY

One of the reasonable enhancements to a basic personal microcomputer would be the expansion of the RAM memory capability. At the end of the time allotted for preparing this thesis, the IBM-XT used in this project was fitted with an accessory "board" which among other additions to the function of the computer, expanded the RAM memory to 640 Kilobytes. The additional cost and the larger memory capacity may allow for a greatly expanded work-area and much larger soil data base to be utilized. Such enhanced equipment may not, however, be commonly available to probable user for some time.

LESA EVALUATION

Pottawatomie County Study Area

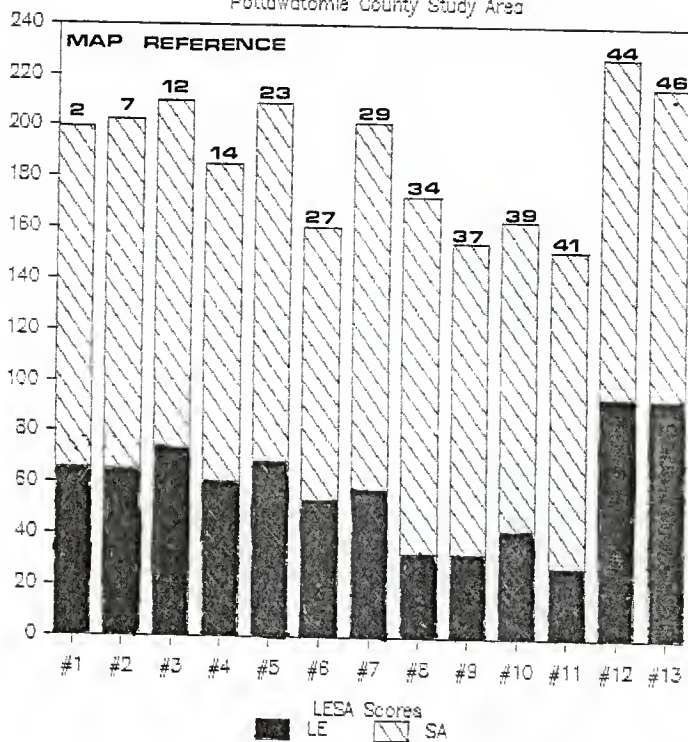


Figure 5.5 Sample summary graph of LESA scores.

A second item which could be incorporated into the function of the computer LESA System would be a graph and map output on screen and through the printer. The LOTUS 1-2-3 program has graphing capability. Using a "normal" microcomputer, a separate utility disk must be used to produce graphs. However,

with the addition of a "graphics board" the LOTUS 1-2-3 can produce a graph on screen similar to the graph shown in Figure 5.5. The IBM-XT has a graphics board which allows the user to design and view a graph on the screen before printing the graph. (Many of the IBM-compatible systems have the graphics capability as a standard feature of their hardware.) The graph process still requires that the user change utility disks even with the graphic board. This would offer a method of illustrating the Land Evaluation, Site Assessment and composite LESA scores other than using the numerical scores.

A function which should be investigated further is the capability of mapping the parcels or sites once they have been evaluated. A software package or system similar to IMGRID or SYMAP (Killpack, 1982) would allow the planner to assign a character to a designated range of LESA scores. This would facilitate the development of maps showing the relative agricultural value of parcels in various tones of gray. Other software packages may allow the data to be interpreted into color maps visible on the screen and color printout with the proper printer.

Other Applications of LOTUS 1-2-3 and the Microcomputer in Land Planning

Although LOTUS 1-2-3 was developed as a financial and accounting tool, it has the capacity to be utilized in other areas as well. The LESA System is only one example of the usefulness the electronic spreadsheet has to land planners. Forecasting and modeling have the same basic theoretical base regardless of the profession applying them to problem-solving.

Any inventory and analysis that uses numerical values or can be converted to numbers is a candidate for adaptation to the computer and spreadsheet. There are several resource analysis methods which could be adapted to the LOTUS 1-2-3 format. McBride (1977) presents a very detailed methodology for a vegetation evaluation in environmental planning. McBride's procedure could be adapted to a

format similar to the Land Evaluation and Site Assessment discussed here. The nineteen vegetation parameters McBride listed could be weighted and evaluated in much the same manner as the LESA site factors.

Other possibilities might include assessment of water resources, watersheds, wildlife habitat, or mined land reclamation. There are other areas in planning and design which are not directly related to resource analysis but have areas where inventory and analysis are used in the problem-solving process. The possibilities for similar application of LOTUS and the microcomputer in construction, bidding and cost estimating, and engineering are innumerable.

In some cases the result may not be much of an improvement over the pad-and-pencil analysis methods, but in situations similar to the LESA example, the results are very rewarding.

Other Applications of the LESA/LOTUS System

The use of the computer LESA System does not necessarily need to be restricted to the evaluation of agricultural land for protection or preservation. Some other areas where this system could be applied might be agricultural land evaluation for taxation or evaluation.

The evaluation could be done by the county assessor or by the county planning staff. In any instance, the site factors would require careful thought and justification. The measuring procedures should be more stringent and the accuracy tolerance decreased.

County Agricultural Extension agents could also provide some assistance to farmers using the LESA System. In counties where no county planning staff exists, the extension agent could provide some economic or financial forecasting services to those farmers concerned with the loss or potential conversion of their land as towns and cities expand. Bank officers might be another category of users for the system providing the same type of services.

CONCLUSIONS

The computer adaptation of the Land Evaluation and Site Assessment System was made relatively easy using the LOTUS 1-2-3 spreadsheet software. The major input on this project was time. A skilled LOTUS user could probably have completed the conversion in a shorter period of time than it took the author. The cost of the microcomputer and the LOTUS software may be a major capital expense for counties with small planning offices, but for decision-making purposes, one which could be justified. The other applications of the hardware and software can justify allocating part of the cost to other functional areas since microcomputers offer a variety of options.

The staff time savings in completing a LESA evaluation using the computer will be significantly reduced. Using the computer LESA will allow the evaluation of approximately six sites in the same amount of time it takes to evaluate one site using the paper and pencil method. The time required to evaluate several sites will facilitate analysis of proposed project sites during a county commission meeting. The if the basic site factor information is available to the planning consultant the LESA analysis could be completed in a matter of minutes. This could easily aid in the decision making process.

Although an evaluation of the LESA system was not within the scope of study for this thesis project, there are some aspects which the author feels should be considered for future exploration. At an unpreceivable point during this study the author realized that the outcome of the site evaluations could be predicted by any person with a basic knowledge of site analysis methods, thus precluding any LESA analysis, computer or otherwise. It would be of interest to compare the results of an agricultural land evaluation using the LESA methodology and standard site analysis procedures. Once the productivity of the soil has been

determined, it is the author's opinion that a "planner" could look at a detailed map of current aerial photograph and predict as accurately as the LESA system, the relative value of an agricultural parcel to a community.

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APPENDIX A

Public Law 97-96
Farmland Protection Act

Subtitle I—Farmland Protection Policy Act

FARMLAND PROTECTION POLICY

SHORT TITLE

Sec. 1523. This subtitle may be cited as the "Farmland Protection Policy Act."

PURPOSE, PURPOSE, AND DEFINITIONS

Sec. 1540. (a) Congress finds that—

(1) the Nation's farmland is a unique natural resource and provides food and fiber necessary for the continued welfare of the people of the United States;

(2) each year, a large amount of the Nation's farmland is irrevocably converted from actual or potential agricultural use to nonagricultural use;

(3) continued decrease in the Nation's farmland base may threaten the ability of the United States to produce food and fiber in sufficient quantities to meet domestic needs and the demands of our export markets;

(4) the extensive use of farmland for nonagricultural purposes undermines the economic base of many rural areas;

(5) Federal actions, in many cases, result in the conversion of farmland to nonagricultural uses where alternative actions would be preferred;

(6) the Department of Agriculture is the agency primarily responsible for the implementation of Federal policy with respect to United States farmland, assuring the maintenance of the agricultural production capacity of the United States, and has the personnel and other resources needed to implement national farmland protection policy; and

(7) the Department of Agriculture and other Federal agencies should take steps to assure that the actions of the Federal Government do not cause United States farmland to be irrevocably converted to nonagricultural uses, and to assure that Federal programs are administered in a manner that, to the extent national interests do not override the importance of the protection of farmland nor otherwise outweigh the benefits of maintaining farmland in use.

(b) The purpose of this subtitle is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses, and to assure that Federal programs are administered in a manner that, to the extent practicable, will be compatible with State, unit of local government, and private programs and policies to protect farmland.

(c) As used in this subtitle—

(1) the term "farmland" includes all land defined as follows:

(A) prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without inconvertible soil erosion, as determined by the Secretary. Prime farmland includes land that possesses the above characteristics but is being used currently to produce livestock and timber. It does not include land already in or committed to urban development or water storage;

(B) unique farmland is land other than prime farmland that is used for production of specific high-value food and fiber crops, as determined by the Secretary. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods. Examples of such crops include citrus, tree nuts, olives, cranberries, fruits, and vegetables; and

(C) farmland, other than prime or unique farmland, that is statewide or local importance for the production of food, feed, fiber, forage, or oilseed crops, as determined by the appropriate State or unit of local government agency or agencies, and that the Secretary determines should be considered as farmland for the purposes of this subtitle.

(2) the term "State" means any of the fifty States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, or any territory or possession of the United States;

(3) the term "unit of local government" means the government of a county, municipality, town, township, village, or other unit of general government below the State level, or a combination of units of local government acting through an advisory agency under State law or an agreement for the formulation of regional development policies and plans;

(4) the term "Federal program" means those activities or responsibilities of a department, agency, independent commission, or other unit of the Federal Government that involve (A) undertaking, financing, or assisting construction or improvement projects or (B) acquiring, managing, or disposing of Federal lands and facilities. The term "Federal program" does not include construction or improvement projects that on the effective date of this subtitle are beyond the planning stage and are in either the active design or construction stage; and

(5) the term "Secretary" means the Secretary of Agriculture.

Sec. 1541. (a) The Department of Agriculture, in cooperation with other departments, agencies, independent commissions, and other units of the Federal Government, shall develop criteria for identifying the effects of Federal programs on the conversion of farmland to nonagricultural uses.

(b) Departments, agencies, independent commissions, and other units of the Federal Government shall use the criteria established under subsection (a) of this section, to identify and take into account the adverse effects of Federal programs on the preservation of farmland; consider alternative actions, as appropriate, that could lessen such adverse effects; and assure that such Federal programs, to the extent practicable, are compatible with State, unit of local government, and private programs and policies to protect farmland.

(c) The Department of Agriculture may make available to States, units of local government, individuals, organizations, and other units of the Federal Government information useful in restoring, maintaining, and improving the quantity and quality of farmland.

ENACTING POLICIES AND PROCEDURES

Sec. 1542. (a) Each department, agency, independent commission, or other unit of the Federal Government, with the assistance of the Department of Agriculture, shall review current provisions of law, administrative rules and regulations, and policies and procedures applicable to it to determine whether any provision thereof will prevent such unit of the Federal Government from taking appropriate action to comply fully with the provisions of this subtitle.

(b) Each department, agency, independent commission, or other unit of the Federal Government, with the assistance of the Department of Agriculture, shall, as appropriate, develop proposals for action to bring its programs, policies, and administrative activities into conformity with the purpose and policy of this subtitle.

TECHNICAL ASSISTANCE

Sec. 1543. The Secretary is encouraged to provide technical assistance to any State or unit of local government, or any nonprofit organization, as determined by the Secretary, that desires to develop programs or policies to limit the conversion of productive farmland to nonagricultural uses.

FARMLAND RESOURCE INFORMATION

Sec. 1544. (a) The Secretary, through existing agencies or inter-agency groups, and in cooperation with the cooperative extension services of the States, shall design and implement educational programs and materials emphasizing the importance of productive farmland to the Nation's well-being and distribute educational materials through communications media, schools, groups, and other Federal agencies.

(b) The Secretary shall designate one or more farmland information centers to serve as central depositories and distribution points for information on farmland issues, policies, programs, technical principles, and innovative actions or proposals by local and State governments.

GRANTS, CONTRACTS

Sec. 1545. The Secretary may carry out the purposes of this subtitle with existing facilities and funds otherwise available, through the use of grants, contracts, or such other means as the Secretary deems appropriate.

REPORT

Sec. 1546. Within one year after the enactment of this subtitle, the Secretary of Agriculture shall report to the Committee on Agriculture, Nutrition, and Forestry of the Senate and the Committee on Agriculture of the House of Representatives on the progress made in implementing the provisions of this subtitle. Such report shall include information on—

(1) the effects, if any, of Federal programs, authorities, and administrative activities with respect to the protection of United States farmland; and

(2) the results of the reviews of existing policies and procedures required under section 1542(a) of this subtitle.

STATEMENT OF LEGISLATION

Sec. 1547. (a) This subtitle does not authorize the Federal Government in any way to regulate the use of private or non-Federal land, or in any way affect the property rights of owners of such land.

(b) None of the provisions or other requirements of this subtitle shall apply to the acquisition or use of farmland for national defense purposes.

PROSECUTION

Sec. 1548. This subtitle shall not be deemed to provide a basis for any action, either legal or equitable, by any State, local unit of government, or any person or class of persons challenging a Federal project, program, or other activity that may affect farmland.

EFFECTIVE DATE

Sec. 1549. The provisions of this subtitle shall become effective six months after the date of enactment of this Act.

APPENDIX B

Prime Farmland Definition

CHARACTERISTICS OF PRIME AND UNIQUE FARMLAND

A. Prime Farmland

1. A monthly moisture supply that equals or exceeds the evapotranspiration during the growing season eight out of ten years. The supply is from stored moisture plus either precipitation or a supplemental water supply that is developed to permit irrigation.

2. A mean annual soil temperature at a depth of 20 inches (50 cm) of more than 32°F (0°C) and a mean summer temperature greater than 47°F (8°C) with an O horizon and greater than 59°F (15°C) without an O horizon.

3. A pH between 4.5 and 8.4 in all horizons within 40 inches (1 meter) or in the root zone if the depth of the root zone is less than 40 inches.

4. No water table or a water table that can be maintained below 1.5 feet (46 cm) during the growing season.

5. Soils that have during part of each year in all horizons within 40 inches (1 meter) or in the root zone if the depth of root zone is less than 40 inches a conductivity of the saturation extract of less than 4 mmhos/cm and an exchangeable sodium percentage (ESP) of less than 15.

6. Soils that are not frequently flooded during the growing season (less often than once in two years).

7. A product of K (erodibility factor) x percentage of slope of less than 2.0.

8. A permeability of at least 0.06 inch (0.15 cm) per hour in the upper 10 inches (50 cm).

9. A surface layer with less than 10 percent rock fragments coarser than 3 inches (7.6 cm).

B. Unique Farmland

1. A moisture supply that is adequate for specific or specialty crops. The supply is from stored moisture, precipitation, or a supplemental water supply that is developed to permit irrigation.

2. A growing season long enough and temperatures warm enough to produce specific or specialty crops.

3. A location that has a unique combination of soil quality, temperature, humidity, air drainage, elevation, aspect or other conditions that favor the growth or distribution of specific or specialty food or fiber crops.

APPENDIX C

Resource Data Required for Farmland Evaluation

THE NATURAL RESOURCE DATA REQUIREMENTS OF
STATE AGRICULTURAL LAND PRESERVATION PROGRAMS

Agricultural land preservation programs contain several types of provisions that directly or indirectly require gathering particular types and scales of data. To assist in implementing various state programs, data gathering could include:

- Mapping soils and farmland by classifications (e.g., prime, unique, etc.);
- Determining amount and quality of land in agricultural use;
- Determining the rate of land use conversion;
- Identifying and inventorying crops/estimating yields;
- Determining economic contributions of agriculture to local economy/cost of agricultural production;
- Inventorying the resources vital to agricultural production (soil, water, etc.);
- Inventorying and analyzing adjacent land uses, urban expansion, etc.;
- Identifying land ownership (e.g., private, corporate, state, etc.);
- Determining environmental effects of agricultural practices;
- Mapping irrigation systems;
- Analyzing social changes as land uses change;
- Calculating revenue gains or losses from sales of property or retaining land in its current use, respectively;
- Analyzing various effects of specific weather patterns on agricultural production (e.g., drought, floods);
- Identifying and researching more cost-efficient crops or farming practices.

Many federal and state agencies have recognized data collection as a long-standing activity in the nation's agricultural programs. Data is essential not only to effective planning and management of current agricultural programs but also to the planning and evaluation of alternative courses of action. The specific data categories addressed in this report identify the broad range required within state programs. The data categories relevant to agricultural and related programs include:

- Water/Hydrology
- Land Use
- Land Cover
- Soils
- Drainage
- Animal Life
- Topography
- Vegetation
- Geology
- Cultural
- Geography
- Climatological/Meteorological
- Land Ownership
- Social/Economic
- Legal

DATA REQUIREMENTS IDENTIFIED WITHIN PROGRAMS DESIGNED TO ENCOURAGE THE PRESERVATION OF AGRICULTURAL LAND

DATA CATEGORY PROGRAMS	GROUNDWATER	SURFACE WATER	LAND USE	LAND COVER	SOILS	DRAINAGE	ANIMAL LIFE	TOPOGRAPHY	VEGETATION	GEOLOGY	CULTURAL	GEOGRAPHY	CLIMATOLOGICAL/ METEOROLOGICAL	LAND OWNERSHIP	SOCIAL/ECONOMIC	LEGAL
PREFERTENTIAL ASSESSMENT			X	X	X									X	X	X
PREFERTENTIAL ASSESSMENT/ INTENDED TAXATION			X	X	X									X	X	X
PREFERTENTIAL ASSESSMENT/ RESERVATION AGREEMENT			X	X	X									X	X	X
CIRCUIT BREAKER STATE			X											X	X	X
INCOME TAX CREDITS			X											X	X	X
INHERITANCE AND ESTATE TAXATION			X											X	X	X
LAND GAINS TAXATION			X											X	X	X
AGRICULTURAL DISTRICTING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AGRICULTURAL ZONING			X	X	X	X		X	X		X			X	X	X
PURCHASE OF DEVELOPMENT RIGHTS			X	X	X	X					X			X	X	X
TRANSFER OF DEVELOPMENT RIGHTS			X	X	X	X					X			X	X	X
LAND USE COMMISSION	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LAND BANKING			X	X	X						X			X	X	X
RIGHT - 10 - YEAR	X	X	X	X	X	X	X				X			X	X	X
INTEGRATED PROGRAMS OF INCENTIVES AND OBLIGATIONS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

STATE PROGRAMS FOR THE PRESERVATION OF AGRICULTURAL LAND (DECEMBER 1981)

STATE	POTENTIAL PROPERTY TAX ASSESSMENT	POTENTIAL PROPERTY TAX ASSESSMENT/DEFERRED TAX	POTENTIAL PROPERTY TAX ASSESSMENT/DEFERRED TAX	POTENTIAL PROPERTY TAX ASSESSMENT/DEFERRED TAX	COUNTY BEARER STATE INCOME TAX CREDITS	INHERITANCE AND ESTATE TAXATION	LAND GAINS TAXATION	AGRICULTURAL DISTRICTS	AGRICULTURAL ZONING	PROBATION OF DEVELOPMENT RIGHTS	PROBATION OF DEVELOPMENT RIGHTS	LAND USE COMMISSION	LAND BANKING	RIGHT - TO - FARM	INTEGRATED PATTERNS OF DEVELOPMENT AND OTHERS
ALABAMA		S				S								S	
ALASKA		S				S					S		L		
ARIZONA	S					S									
ARKANSAS	S					S									
CALIFORNIA			S			S									
COLORADO	S					S									
CONNECTICUT	S					S	S								
DELAWARE	S					S			L	L				S	
FLORIDA	S					S									
GEORGIA						S								S	
HAWAII		S	S	S					S			S	S	S	S
IDaho	S					S				L		S			
ILLINOIS	S	S				S		S						S	
INDIANA	S									L					
IOWA	S									L					
KANSAS		S				S				L				S	
KENTUCKY		S				S								S	
LOUISIANA	S													S	
MAINE		S								L					
MARYLAND		S				S		S		L	L			S	S
MASSACHUSETTS		S							S/L	L					
MICHIGAN			S	S	S	S								S	
MINNESOTA		S	L*			S			L					S	
MISSISSIPPI	S					S									
MISSOURI	S														
MONTANA	S					S								S	
NEBRASKA		S								L					
NEVADA		S													
NEW HAMPSHIRE			S							L					
NEW JERSEY		S								L	L				
NEW MEXICO	S					S									
NEW YORK		S				S		S		L	L			S	
NORTH CAROLINA		S												S	
NORTH DAKOTA	S					S			L					S	
OHIO		S													
OKLAHOMA	S													S	
OREGON		S				S			S			S		S	S
PENNSYLVANIA		S	S			S		S		L	L	S	S	S	S
RHODE ISLAND		S								S			S	S	
SOUTH CAROLINA		S													
SOUTH DAKOTA	S									L					
TENNESSEE		S				S							S	S	
TEXAS		S													
UTAH	S					S				L				S	
VERMONT		S				S	S							S	
VIRGINIA		S				S		S		L				S	
WASHINGTON		S				S				L			S	S	
WEST VIRGINIA	S														
WISCONSIN			S	S					S						S
WYOMING	S									L					
VIRGIN ISLANDS						S						S	S		
GUAM															

Source: Combined data from 1979 NCSL/CEQ Survey, 1981 NCSL Survey and NALS Data.

S = Statute of State Program. L = Local Program (s)

* = one town only - no results ** = metropolitan (Twin Cities area only)

EXHIBIT #C-3

(Source: Klein, 1982)

KANSAS

PREFERENTIAL PROPERTY TAX ASSESSMENT WITH DEFERRED TAXATION

KANS. CONST., Art.11, Sec.12. This 1976 amendment to the Kansas Constitution authorizes use value assessment for agricultural land. The legislature may define agriculturally used land and may provide for rollback taxes if preferentially assessed land is converted to other uses.

Several bills to implement the above amendment have been introduced in the Kansas legislature during the 1977, 1978, and 1979 sessions. H.B. 2732 (1978) is an example. It defines land devoted to agricultural use, describes procedures for determining of farm use value, and requires a six-year rollback for any change in use.

INHERITANCE AND ESTATE TAXATION

1978 Kan. Sess. Laws, Chap. 397 (S.B. No. 976). This act provides that farmland of a decedent transferred to a surviving spouse shall be eligible for estate tax relief based on a farm use valuation assessment similar to Section 2032A of the Federal Estate Tax Law. The reduction in value of such property cannot exceed \$500,000. The land must have been used as a farm for five of the last eight years and owned by the decedent or his or her family, with material participation by the decedent or a member of his or her family in farming operations. The statute provides similar estate tax relief for owners of real property used in a trade or business.

Valuation of a farm under this law is determined in one of two ways. One is by dividing (a) the amount by which average annual gross rental for comparable farmland in the same locality exceeds average annual state and local property taxes for comparable farmland, by (b) the "average annual effective interest rate for all new federal land bank loans." The other method considers such factors as capitalization of income, fair rental value, assessed land values in the state, and comparable sales of nearby farmland. This second method is used at the election of the executor, or when there is no comparable land from which to determine average annual gross cash rental.

The state law also incorporates similar provisions of Section 6166 of the Federal Estate Tax Law providing the option of deferred estate tax payments over a period of years.

APPENDIX D

Pottawatomie County Agricultural
Land Zoning Ordinances

ARTICLE 4

AGRICULTURAL ZONING DISTRICTS

100. A-1, Agricultural District

This district is intended to conserve and promote the preservation of productive agricultural areas and to allow certain uses convenient to the agricultural community to develop in a low density pattern.

A. Permitted Uses

1. Agricultural uses including farming, animal husbandry, poultry, fur bearing animals and other livestock; truck gardening, orchards, bee keeping and the sale of food products grown in agricultural districts.
2. Single family dwelling units on two or more acres.
3. Accessory uses for agricultural and single family dwelling units.
4. Mobile homes used in conjunction with farming enterprises as long as the mobile home is occupied by members of the farm family or employees, but cannot be used solely for rental purposes.
5. Public and/or private schools.
6. Greenhouses and nurseries, parks and community buildings or meeting halls.
7. Exploration and extraction of oil and natural gas.
8. Home occupations provided that such occupations take place within the principal dwelling, or, on lots of 80,000 square feet or more, in an accessory building that shall be no larger than 14' x 20', or 280 square feet. One sign shall be permitted, no greater than sixteen (16) square feet. Business shall be run by no more than one employee and one assistant.

B. Exceptions.

1. Campgrounds
2. Kennels for breeding and boarding dogs provided that they are located no closer than one thousand feet from the nearest residential property line. All kennels shall provide screening for the reduction of noise.
3. Repair of farm machinery and other motorized equipment, including automobiles.
4. Theaters, including drive-ins.
5. Riding stables, adult or family parks, retreats or recreational facilities for group living, gun clubs, rodeo grounds, sale and

display of farm products and the storage of fertilizers and fuels.

C. Area and Setback Requirements.

1. The minimum lot size for any use in A-1 districts shall be two (2) acres, except for uses by units or agencies of government.
2. One zoning lot is equal to two (2) acres for a residence. Each residence requires one zoning lot.
3. The minimum setback for any building shall be thirty-five (35) feet from the front lot line.

D. Requirements for Exceptions.

1. In addition to the requirements for exceptions listed in these resolutions in Article 2, 105A, any use used as an exception in A-1 which adjoins residential areas shall be screened from view by a minimum six foot fence or tree barrier.

101. A-2, Rural Center District

The purpose of the rural center zoning district is to allow the small farm cluster communities and the unincorporated centers to continue as places of residence, commercial sales and community convenience.

A. Permitted Uses.

1. Single family residential units, two and three family units and multi-family residential units.
2. Agricultural commercial; the sale of farm machinery and the repair of equipment.
3. Retail commercial sales.
4. Public or private schools.
5. Community meeting or group meeting facilities.
6. Service Commercial.
7. Package sales, taverns and bars.
8. Churches.
9. Mobile homes on permanent foundations.

B. Area and Setback Requirements.

1. In any A-2 district, the minimum lot size shall be 80,000 square feet if individual wells and septic systems are used.
2. The minimum lot size if either central water or sewer is available shall be 20,000 square feet.

APPENDIX E

Pottawatomie County Soil Survey
Draft

			MLRA	Class	K	T	PK	BL	SL	CL	LL	PL	FR	FR
1d	Reddish silty clay loam, 1-4% clay	K50055	106.76	CL 24	.37	3	8	7	4U	C	No	None	IV	
2	Reddish-brown clay loam, 2-4% clay	K50055	106.76	CL 24	.37	3	8	7	4U	C	No	None	V	
		Fraser	K50039	106.76	CL	.38	3	11	5	4U	C	None	None	
3a	Reddish-brown clay loam, 1-12% clay	NE0016	106	CL	.38	5	9	6	4U	R	No	None	III	
3e	Chesapeake silty clay loam	K50018	76.186	CL 24	.37	5	14	7	4L	C	Yes	None	IV	
3m	Silty, silty clay loam, 2-4% clay	K50022	76	CL 24	.30	4	20	2	4U	C	No	None	V	
3s	Clayey-sandy silty clay loam	K50022		106							No	None	VI	
		Clina	K50022	106.76	CL	.37	4	11	4L	4U	C	None	None	
		Sage	K50026	106.76	CL	.32	1	3	4L	SL	D	None	None	
3n	Elmwood silty clay loam, 3-4% clay	K50024	76.186	CL	.32	5	16	6	4U	B	Yes	None	III	
3o	Elmwood silty clay loam, 3-4% clay	K50024	76.186	CL	.32	5	16	6	4U	B	Yes	None	III	
3u	Eudora silty loam	K50037	106.76	CL	.32	5	16	5	4L	R	Yes	None	I	
3x	Eudora-Kima complex										Yes	None	II	
		Eudora	K50037	106.76	CL	.32	5	6	5	1E	B	Yes	None	
		Kima	K50059	106.76	CL 24	.37	5	10	4	CL	C	Yes	None	
3m	Gypsum silty clay loam, 3-4% clay	K50045	106	CL 24	.32	5	6	4U	C	Yes	None	III		
4n	Hays silty clay loam, 2-4% clay	TR0170	106.76	CL 24	.37	5	-	4L	4L	R	Yes	None	IV	

EXHIBIT #E-1

(Source: Soil Conservation Service State Office, Kansas, Unpublished)

[illegible]

[illegible]

EXHIBIT #E-3

(Source: Soil Conservation Service State Office, Kansas, Unpublished)

APPENDIX F

Shawnee County Site Assessment Criteria

Introduction:

The Agricultural Lands Evaluation and Site Assessment System (LESA) was developed by the U.S. Soil Conservation Service (SCS) to serve as a tool to assist local governments in making agricultural land use decisions. The LESA system is designed not only to determine the physical quality of the site for agricultural uses, it also assesses the social/economic factors affecting the site to determine its agricultural economic viability. The LESA system was piloted in 12 counties in six states, and has proven to be a consistent and technically defensible basis for land use decisions.

The LESA system is divided into two sections. The first, the Agricultural Land Evaluation, uses SCS data to assess such physical characteristics as soil types, capabilities and productivity. The second section, the Site Assessment, assigns values to factors which have been determined to affect land use decisions.

Agricultural Lands Evaluation:

(Data for the Land Evaluation section was obtained primarily from the Shawnee County Soil Survey, with supporting data drawn from the State Board of Agriculture Farm Facts and ASCS Proven Yield samples.)

Soils were first listed according to their land capability classification, and the important farmland classification and productivity index for each soil was included. (Grain sorghum was chosen as the indicator crop as it is the most universally grown throughout the County.) The soils were then re-grouped into ten divisions according to productivity characteristics, and a relative value for each group was calculated, based upon the adjusted yields.

Site Assessment:

The Site Assessment section provides a system for identifying those factors (other than soils) which contribute to the agricultural viability of a given site. The Agriculture Advisory Committee determined the following factors to be the most responsive to the stated goals of preserving agricultural lands and encouraging efficient development patterns within the planning area. Point values were assigned according to the degree of continuing support for agriculture -- i.e., the maximum number of points are assigned when the on-site conditions, favor the continuation of agricultural use. Weights were assigned to each factor according to its importance in attaining the planning goals (10 is assigned to the most significant factor.)

Site Assessment Factors:

- 1.) Percentage of area in agricultural use within 1/2 mile of the proposed site.

10	90 - 100%	Weight: 5
9	75 - 89%	
6	50 - 74%	
3	25 - 49%	
0	0 - 24%	

Intent: Areas which are 100% agricultural are more viable for continued agricultural use than are those which are mixed. The half mile radius was selected by the committee as being large enough to evaluate land uses in the area, and small enough to remain workable.

- 2.) Percent of land adjacent to the proposed site in agricultural use.

10	90 - 100%	Weight: 9
9	75 - 89%	
6	50 - 74%	
3	25 - 49%	
0	0 - 24%	

Intent: While the general character of the area is important in determining a site's potential for agricultural use, the uses which are immediately adjacent to the proposed site have a much greater influence. The more adjacent land in non-agricultural use, the greater the potential for land use conflicts and conversion pressures.

- 3.) Percent of the proposed site in agricultural use.

10	90 - 100%	Weight: 6
9	75 - 89%	
6	50 - 74%	
3	25 - 49%	
0	0 - 24%	

Intent: This factor serves to determine the current use of the property, as well as to provide an indication of the site's suitability for agricultural use.

- 4.) Percent of land zoned "agriculture" within 1/2 mile of the proposed site.

10	90 - 100%	Weight: 7
9	75 - 89%	
6	50 - 74%	
3	25 - 49%	
0	0 - 24%	

Intent: Zoning regulations carry the police power; areas which are zoned consistently for agriculture receive more protection than those areas which are zoned for a variety of uses.

- 5.) Availability of adequate land appropriately zoned for the proposed use.

10	Adequate land, appropriately zoned and undeveloped is available within the projected urban service areas.	Weight: 7
0	Land appropriately zoned and undeveloped is unavailable or inadequate.	

Intent: This factor is designed to prevent the unnecessary rezoning of additional land outside of the urban service areas when adequate alternative sites are available.

- 6.) Impact of the proposed conversion on the retention of other agricultural lands and support systems in the area.

10	Negative Impact	Weight: 8
5	Little or no impact if special considerations are addressed	
0	No Impact	

Intent: This factor is intended to distinguish between those types of development which have minimal effect on agricultural operations and those, such as residential developments, which have a maximal effect.

7.) Impact of the proposed use on the drainage patterns, floodplains and water quality.

- 10 Negative Impact
- 5 Little or no impact if special considerations are addressed
- 0 No Impact

Weight: 8

Intent: This factor is designed to protect sensitive areas from damage due to inappropriate development, and to maintain the environmental quality of the planning area.

8.) Impact of the proposed use on air quality and noise.

Weight: 4

- 10 Negative Impact
- 5 Little or no impact if special considerations are addressed
- 0 No Impact

Intent: This factor is designed to assist in minimizing the potential for conflicting land uses, as well as to maintain the environmental integrity of the planning area.

9.) Impact of the proposed use on the historic/cultural resources and recreational/open space of the area.

Weight: 1

- 10 Negative Impact
- 5 Little or no impact if special considerations are addressed
- 0 No Impact

Intent: This factor is designed to assist in protecting these resources when they are threatened by a proposed development/use. (Note - this factor is weighted low as it is not anticipated to be relevant to all cases.)

10.) Availability of Municipal Water Service to proposed site.

Weight: 6

- 10 Water service is unavailable
- 9 Site is serviced by a Rural Water District
- 6 Water service is presently unavailable, but is projected for 2025
- 3 Water service is presently unavailable, but is projected for 2005
- 0 Water service is available

11.) Availability of Municipal Sanitary Sewer to proposed site.

Weight: 4

- 10 Sewer unavailable; septic unsuitable
- 9 Sewer unavailable; septic suitable
- 6 Sewer is presently unavailable, but is projected for 2025
- 3 Sewer is presently unavailable, but is projected for 2005
- 0 Sewer is available

Intent: This factor is designed to guide development to areas where the municipal infrastructure exists, as well as to prevent development on soils which are incapable or insufficient for septic disposal systems.

12.) Compatibility of the proposed use with the Comprehensive Growth Management Plan.

Weight: 10

- 10 Incompatible
- 5 Compatible with the intent of the plan, but not the Official Map
- 0 Totally compatible

Intent: All land use changes should be compatible with intent of the Plan, and the policies contained therein.

13.) Suitability of the site for proposed use.

Weight: 5

- 10 Site is not suitable
- 5 Alternative sites are available which are equally or better suited for the proposed use
- 0 Site is uniquely suited for the proposed use

Intent: This factor is designed to consider the possibility that the proposed site is unique due to one or more natural or manufactured features.

14.) Presence and adequacy of an Agricultural Support System.

Weight: 2

- 10 An adequate Agricultural support system is present
- 5 A limited support system is present
- 0 A support system is lacking

Intent: The agricultural support system (including, but not limited to farm implement dealers, farm supply stores, grain elevators, etc.) in Shawnee County is at present adequate and accessible

15.) Economic/Social Importance of the proposed use to the community.

- Weight: 7
- 10 The community has not demonstrated a specific need for the proposed use. (No significant economic/social benefits will be recognized.)
- 5 The proposed use has some economic/social benefit to the community. (Approximately equal to those lost by the proposed change.)
- 0 The community has demonstrated a significant need for the proposed use, and significant benefits will realized.

Intent: This factor is designed to weigh the economic and social costs and benefits of a proposed use (ie the loss of crop production, the amount of jobs and tax revenue generated etc.)

16.) Location of the proposed site.

- Weight: 7
- 10 Site is in the Rural Service Area
- 5 Site is in the Secondary Urban Service Area
- 0 Site is in the Urbanized or Primary Urban Service Area

Intent: This factor is designed to re-enforce the policies of the Comprehensive Growth Management Plan.

17.) Transportation and Accessibility.

- Weight: 5
- 10 Transportation/access to the proposed site is limited (site is served primarily by rural township roads.)
- 9 Site has access to a major thoroughfare within 1/2 mile.
- 6 Site has immediate access to a major thoroughfare.
- 3 Site has access to a major highway/railroad within 1/2 mile.
- 0 Site has immediate access to a major highway/railroad.

Intent: Sites which have immediate access to major transportation routes are more likely to be subject to conversion pressures than are those with access only by rural roads.

18.) Availability of utilities.

- Weight: 3
- 10 Utilities are available at developer expense.
- 5 Utilities are currently planned for extension to site.
- 0 Site is currently served.

Intent: This factor is designed to reinforce the policies of the Comprehensive Growth Management Plan.

Application Procedures:

The following is the procedure for calculating the total land evaluation and site assessments for a given site. All calculations should be recorded on Summary Sheets (see Appendix).

Agricultural Land Evaluation:
(Summary Sheet #1)

- 1.) Locate the proposed site on the soil survey map and determine the soil types present.
- 2.) Determine the acreage of each soil type, place in the appropriate agricultural group and determine the total acreage in each group.
- 3.) Determine the percentage of the total site in each agricultural group.
- 4.) Multiply the percentage of each group by the relative value for that group.
- 5.) Add the values from step 4 to obtain the average site value.
(Maximum site value possible = 100.)

Site Assessment:
(Summary Sheet #2)

- 1.) Determine point value for each site assessment factor by determining which of the pre-established categories best applies to the property in question. (NOTE: If the subject site falls between 2 categories, a mid-range point value may be assigned.)
- 2.) Multiply the point value by the established (adjusted) weight for each factor to determine the factor value.
- 3.) Add all factor values to determine the total site assessment value.
(Maximum site assessment possible = 200.)

SUMMARY SHEET #1
AGRICULTURAL LANDS EVALUATION

AGRICULTURAL GROUP	ACREAGE	% OF SITE	X	RELATIVE VALUE =	SITE VALUE
1	_____	_____	X	100	= _____
2	_____	_____	X	83	= _____
3	_____	_____	X	70	= _____
4	_____	_____	X	63	= _____
5	_____	_____	X	59	= _____
6	_____	_____	X	58	= _____
7	_____	_____	X	47	= _____
8	_____	_____	X	44	= _____
9	_____	_____	X	0	= _____
10	_____	_____	X	0	= _____

Total =

TOTAL = AVERAGE SITE VALUE

SITE ASSESSMENT

FACTOR	MAXIMUM POINTS/ FACTOR	ASSIGNED WEIGHT	WEIGHT ASSIGNED POINTS	*ADJUSTED WEIGHT	*ADJUSTED MAXIMUM POINTS
1) 1 of area in agricultural use within 1/2 mile of site	10	5	50	.960	9.60
2) 1 of land adjacent to site in agricultural use	10	9	90	1.728	17.28
3) 1 of site in agricultural use	10	6	60	1.152	11.52
4) 1 of land zoned agriculture within 1/2 mile of site	10	7	70	1.344	13.44
5) Availability of adequate, appropriately zoned land	10	7	70	1.344	13.44
6) Impact of the proposed conversion on the retention of other ag lands	10	8	80	1.536	15.36
7) Impact on drainage/floodplain/ water quality	10	8	80	1.536	15.36
8) Impact on air quality/noise	10	4	40	.768	7.68
9) Impact on historic/cultural & recreational/open space	10	1	10	.192	1.92
10) Municipal water service	10	6	60	1.152	11.52
11) Municipal sanitary sewer	10	4	40	.768	7.68
12) Compatibility with ^{Jefferson County} growth management plan	10	10	100	1.920	19.20
13) Site suitability	10	5	50	.960	9.60
14) Agriculture support system	10	2	20	.384	3.84
15) Economic/social importance	10	7	70	1.344	13.44
16) Location	10	7	70	1.344	13.44
17) Transportation/Accessibility	10	5	50	.960	9.60
18) Utilities	10	3	30	.576	5.76
			<u>1030</u>	<u>.576</u>	<u>199.68</u> (200)

*Adjusted weight = 200 ÷ 1030 = .192

SUMMARY SHEET #2

SITE ASSESSMENT

SITE ASSESSMENT FACTOR	POINT VALUE	X	ADJUSTED = WEIGHT	FACTOR VALUE
1.) % of area in agricultural use	_____	X	.960	= _____
2.) % of adjacent land in agricultural use	_____	X	1.728	= _____
3.) % of site in agricultural use	_____	X	1.152	= _____
4.) % of area zoned agriculture	_____	X	1.344	= _____
5.) Availability of zoned land	_____	X	1.344	= _____
6.) Impact on agricultural lands	_____	X	1.536	= _____
7.) Impact on drainage/floodplain/water quality	_____	X	1.536	= _____
8.) Impact on air quality/noise	_____	X	.768	= _____
9.) Impact on historic/cultural resources and recreation/open space	_____	X	.192	= _____
10.) Municipal water service	_____	X	1.152	= _____
11.) Municipal sanitary sewer	_____	X	.768	= _____
12.) Compatibility with plan	_____	X	1.920	= _____
13.) Site suitability	_____	X	.960	= _____
14.) Ag support system	_____	X	.384	= _____
15.) Economic/social importance	_____	X	1.344	= _____
16.) Location	_____	X	1.344	= _____
17.) Transportation/Accessibility	_____	X	.960	= _____
18.) Utilities	_____	X	.576	= _____

TOTAL =

TOTAL = SITE ASSESSMENT VALUE

Determining Economic Viability:

To determine the total score for a given site, add the average Site Value (from Summary Sheet #1) to the Site Assessment Value (from Summary Sheet #2). The maximum total points possible for any given site is 300; this value determines the economic viability of the site for protection purposes.

- *Sites having 350 + points should receive extremely high protection efforts
- *Sites ranging from 225-249 points should receive high protection efforts
- *Sites ranging from 200-224 points should receive moderate protection
- *Sites having fewer than 200 points should receive low protection efforts

APPENDIX G

Soil Data Field Worksheets

CASE STUDY SITE DATA

PAGE 1

SITE # 2 TOTAL ACRES : 40±

MAP NUM	MAP SYM	ACRES	PROD RATING	TOTAL ACRES	WEIGHTED INDEX
	KF	B			
	Gm	16			
	Um	12			
	Mo	40			

MAJOR HWY 1/2 mile to gravel
Utilities (E) 1/2 mile
City services 3 1/2 miles

Surrounding land w/ 1 mile ag
adjacent ag

Total for Site #

SITE # 7 TOTAL ACRES : 160±

MAP NUM	MAP SYM	ACRES	PROD RATING	TOTAL ACRES	WEIGHTED INDEX
	Um	32			
	Gm	56			
	KF	16			
		164			

Major highway 1 mile gravel turn
Utilities (E) 1/2 mile
City services 2 1/2 miles

Surrounding land w/ 1 mile 80% ag
adjacent land ag

Total for Site #

SITE # 12 TOTAL ACRES : 160-180±

MAP NUM	MAP SYM	ACRES	PROD RATING	TOTAL ACRES	WEIGHTED INDEX
	Gm	56			
	KF	64			
		120			

80% ag
40% housing/road/cemetery
4 1/2 to all roads
1/2 to Utilities

80% ag 20% housing

1 mile to City Services

Total for Site #

SITE # 14 TOTAL ACRES : 40±

MAP NUM	MAP SYM	ACRES	PROD RATING	TOTAL ACRES	WEIGHTED INDEX
	Gm	16			
	Um	24			
		40			

2 1/2 mile to all roads
1/2 to city services
50% ag 50% other adj. surrounding

Total for Site #

SITE # 23 TOTAL ACRES : 40±

MAP NUM	MAP SYM	ACRES	PROD RATING	TOTAL ACRES	WEIGHTED INDEX
	Um	28			
	Mo	16			
		44			

2 1/2 mile to all roads
2 miles to City Services
2 1/2 mile to Utilities

80% ag 20% housing adjacent
20% ag 10% other surrounding

Total for Site #

SITE # 28 TOTAL ACRES : 160±

MAP NUM	MAP SYM	ACRES	PROD RATING	TOTAL ACRES	WEIGHTED INDEX
	Um	16			
	Mo	36			
	Ud	20			
	MT	16			
	KF	28			
	BT	8			
	CC	20			
		152			

4 miles to all roads
2 miles to City Services
2 1/2 mile to Utilities

80% ag 20% housing

1 mile to City Services

Total for Site #

CASE STUDY SITE DATA

PAGE 2

SITE SELECTED BY RANDOM NUMBER

SITE # 29 TOTAL ACRES : 80

SITE # 39 TOTAL ACRES : 160

MAP NUM	MAP SYM	ACRES SERIES	PROD RATING	TOTAL WEIGHTED ACRES	INDEX
	WD	20			
	Mo	50			
		76			

MAP NUM	MAP SYM	ACRES SERIES	PROD RATING	TOTAL WEIGHTED ACRES	INDEX
	PC	12			
	MT	12			
	OT	12			
	Mo	56			
	OP	28			
	TH	16			
	WD	4			
	WE	20			

1 1/2 miles to city, Utl
 1/2 to electric
 1/2 mile to major road
 adjacent land ag
 80% surrounding land ag

some
 10% H

Total for Site #

Total for Site #

SITE # 34 TOTAL ACRES : 180

SITE # 41 TOTAL ACRES : 70 ±

MAP NUM	MAP SYM	ACRES SERIES	PROD RATING	TOTAL WEIGHTED ACRES	INDEX
	Mo	28			
	WD	8			
	WE	104			
	ET				

MAP NUM	MAP SYM	ACRES SERIES	PROD RATING	TOTAL WEIGHTED ACRES	INDEX
	OP	36			
	OT	16			
	MT	16			
	TH	4			
		76			

1 1/2 miles to city
 West on site
 1/2 mile to gravel
 1 mile to power
 10% surrounding land ag 80
 gravel 20%

1/2 mile to city
 1/2 to Utl
 1/2 to all services
 100% adjacent
 100% surrounding

Total for Site #

Total for Site #

SITE # 37 TOTAL ACRES : 60

SITE # 44 TOTAL ACRES : 70 ±

MAP NUM	MAP SYM	ACRES SERIES	PROD RATING	TOTAL WEIGHTED ACRES	INDEX
	WE	52			
	Mo	12			

MAP NUM	MAP SYM	ACRES SERIES	PROD RATING	TOTAL WEIGHTED ACRES	INDEX
	Mo	52			
	KM	20			
		72			

1/2 to all roads
 1/2 to rail
 1/2 to city
 1/2 to Utl
 100% ag

surrounded by road
 1 mile to city
 1/2 to all services
 100% adjacent
 100% surrounding

Total for Site #

Total for Site #

CASE STUDY SITE DATA

PAGE 3

ALT

SITE # 46 TOTAL ACRES : 40

SITE # A TOTAL ACRES : 240

MAP NUM	MAP SYM	ACRES	PROD SERIES	RATING	TOTAL WEIGHTED ACRES	INDEX

MU 40

50% ag adj
50% surrounding
roads adjacent

MAP NUM	MAP SYM	ACRES	PROD SERIES	RATING	TOTAL WEIGHTED ACRES	INDEX

Wm 88 46
Em 88 20
Mo 88 76 / 222
Kc 20
Raven north

Total for Site # =

ALTB Total for Site # = 256

SITE # 52 TOTAL ACRES : 80

SITE # TOTAL ACRES :

MAP NUM	MAP SYM	ACRES	PROD SERIES	RATING	TOTAL WEIGHTED ACRES	INDEX

MU

EM

EX

MAP NUM	MAP SYM	ACRES	PROD SERIES	RATING	TOTAL WEIGHTED ACRES	INDEX

Wm 88 183
Em 88 26
Mo 88 36
Mt 88 40
Kc 88 20
Wd 88 280 20

Total for Site # =

Total for Site # =

SITE # 53 TOTAL ACRES :

MAP NUM	MAP SYM	ACRES	PROD SERIES	RATING	TOTAL WEIGHTED ACRES	INDEX

EX

EX

EX

EX

EX

EX

EX

EX

EX

EX

EX

EX

EX

EX

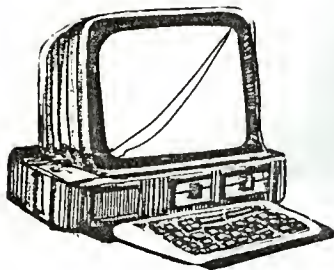
EX

Total for Site # =

EX

APPENDIX H

Software and Hardware used in the Study



HARDWARE

IBM-PC - personal computer
- 256K Random Access Memory
- two 5¼" Floppy Disk Drives (DS-DD)
- Monochrome Monitor

Zenith - personal computer
- 256K Random Access
- one 5¼" Floppy Disk Drive (DS-DD)
- one 10 Megabyte Hard Disk Drive
- Amber Chrome Monitor

IBM-XT - personal computer
- 640K Random Access Memory
- one 5¼" Floppy Disk Drive (DS-DD)
- one 10 Megabyte Hard Disk Drive
- Color Monitor
- Hercules Graphics Card

Epson FX-100 Dot Matrix Printer - Parallel-Port Printer

SOFTWARE

LOTUS 1-2-3 - Electronic Spreadsheet
System Requirements: IBM or PC-Dos/128K
two Disk Drives (DS-DD)
Parallel- or Serial-Port Printer
Graphics Capability (optional)

WORDSTAR - Word Processing
System Requirements: IBM or PC-DOS/128K
two Disk Drives (DS-DD)
Printer

WORD PERFECT - Word Processing
System Requirements: IBM or PC-DOS/128K
two Disk Drives (DS-DD)
Printer

APPENDIX I

Manual
LESA/LOTUS Spreadsheet

USER MANUAL FOR THE LESA/LOTUS SYSTEM
FOR AGRICULTURAL LAND EVALUATION

THESIS PROJECT - SPRING 1985

MICHAEL SPACKMAN

DEPARTMENT OF LANDSCAPE ARCHITECTURE

KANSAS STATE UNIVERSITY

MANHATTAN, KS

KENNETH BROOKS - MAJOR PROFESSOR

IBM-PC is the registered trade name for the IBM personal computer.

LOTUS 1-2-3 is the registered trade name for LOTUS Development Co.

INTRODUCTION

The Land Evaluation and Site Assessment System (LESA) is a nationally recognized agricultural land evaluation tool. Planners and elected officials at the county level can utilize the LESA System to determine the agricultural viability of agricultural parcels for the purpose of protecting the best farmland from non-agricultural production uses. The system can be used to determine, for decision-making purposes, which land is best suited for retention as agricultural land and which land is more appropriate for development.

The attached document is a users' guide to a computer version of the LESA System. The LESA concept was adapted to an electronic spreadsheet, LOTUS 1-2-3. LOTUS 1-2-3 was chosen to facilitate designing a computer version which resembled the paper worksheets as much as possible. The worksheets in LOTUS 1-2-3 look as much like the Site Assessment and Land Evaluation paper worksheets as is permissible on the computer monitor. The LESA worksheets are "templates" which can be used over and over again without reconstructing them. The data entered on the worksheets can be saved for later reference or printed to paper for documentation purposes. Blank worksheets can be printed to paper for data collection purposes. This will speed the data entry process by having the data for each site organized in the same manner it is entered from the keyboard.

This tutorial guide to the LESA/LOTUS system is presented as an appendix to the accompanying Master's Thesis. The manual is not designed to be a comprehensive user manual for LOTUS 1-2-3 nor is it a complete step-by-step procedure for the LESA/LOTUS Agricultural Land Evaluation spreadsheet. The manual is a partial documentation of the process and idiosyncracies of the LESA worksheets.

There are no error trapping mechanisms designed into this worksheet--the user is cautioned to double check entries before pressing the RETURN key.

EQUIPMENT REQUIRED:

- * IBM-PC or Compatable microcomputer with 256 kilobytes of random access memory.
- * LOTUS Spreadsheet Software - LOTUS Development Corporation.

START-UP

1. Place the LOTUS Systems Disk in Drive A.
Place the LESA System Disk in Drive B and turn on the computer.
2. Follow the normal entry procedure to open a 1-2-3 file.
 - a. Select 1-2-3.
 - b. "Press any key to continue."
3. The LESA worksheet file is named AUTO123.WKS which LOTUS will automatically load into memory.
 - a. The LESA disk contains 2 files: AUTO123.WKS (the worksheet file) and a second file SUMMARY.PIC which is the graph picture file. The graph file cannot be used unless the operator changes to the print graph system disk or the computer has graphics capability.
4. After the LESA worksheet is loaded into the system, the first image to appear on the monitor will be the map of the worksheet along with a menu of tasks which appears above the map (Figure 1.1)

```

=====
|***PLEASE CHOOSE A TASK FROM THE MENU ABOVE THIS MAP***|
|THIS IS A MAP OF THE SPREADSHEET "AUTO123.WKS"--LESA System.|
=====
|
|           |           |           |           |
|   SITE ASSESSMENT   |   EVALUATION   |   MACROS   |   LESA   |
|   WORK SHEET        |   WORKSHEET   |   (BBI)    |   WEIGHTING|
|   (S A)             |   (LE)       |   MENU     |   MODEL    |
|   (site factors)    |   (soils)    |             |             |
|   (A1)              |   (AA1)      |             |             |
|=====|=====|=====|=====|
| SUMMARY SHEET       |   LAND       |             |             |
|                     |   EVALUATION |             |             |
|   (LE SA)           |   WORK       |             |             |
|   (C 70)           |   AREA       |             |             |
|=====|=====|=====|=====|
|*****|***To escape from MACRO, Press CTRL/BREAK.***|
| MAP OF |***To restart the MACRO, Press ALT S***|
|SPREADSHEET |<=====You are here|
|=====|

```

Figure 1.1 - Map of LESA

5. Choose one of the tasks from the menu by using the cursor keys and to highlight the desired choice. Then press the RETURN key to execute the command.
- a. To escape from the automated macro program choose MAN/calc or press the CTRL and BREAK keys, either sequence will return the system over to the READY mode which is the standard LOTUS command program.

1.0 - ENTRY MENU/MAIN MENU OPTIONS

****The user may choose one of the following from the Main Menu which appears above the LESA map.

- 1.1. LE/soils - will bring the Land Evaluation worksheet and menu to the screen. From this menu the user may proceed to evaluate the soils for a specific site. PAGE 4-6.
- 1.2. SA/site - will bring the Site Assessment worksheet and menu to the screen. From this menu the user may proceed with the evaluation of the social and economic aspects of the site. PAGE 7-9.
- 1.3. SUMMARY - selecting SUMMARY will bring the LESA Summary sheet to the screen to be reviewed. From the Summary Menu the user may continue the LESA evaluation or may generate a paper copy of the Summary sheet. If the computer has graphics capability the user may view a graph of the scores by press the function key F10. PAGE 10-11.
- 1.4. QUIT/Save - this selection will initiate a series of prompts which will lead the user through a sequence of entries which will save the data only, to a new file for later reference. This will also return the program to the standard LOTUS READY mode. PAGE 12.
- 1.5. MAN/calc - If the user is familiar with the LESA System and LOTUS the LESA worksheet can be used without the assistance of the automated sequence or the menus. The system can be worked independent of the macro program at any point by pressing CTRL BREAK and clearing any window or title commands. This should not be attempted unless the user is familiar with the LOTUS System. To re-enter the macro sequence press ALT S.
- 1.6. "WHAT IF?" - will bring the weighting model template to the screen along with two menu selections. The first selection will return the user to the Main Menu. The second selection will allow the user to manipulate any of the weighting or point criteria.
- 1.7. See Figure 1.1 for the location of each of the work areas.
- 1.8. Range Names: Using the F5 function key and entering these Range Names will place the cursor at the upper left corner of the specific work area when the macro sequence has been exited by pressing CTRL/BREAK. PAGE 12.

2.0 - LAND EVALUATION - LE

****BEFORE BEGINNING THE LAND EVALUATION WORKSHEET YOU MUST HAVE THE FOLLOWING INFORMATION...

1. The total acreage for each site to be evaluated.
2. The acreage for each soil found on each site to be evaluated.
3. The current soil data for the location entered into the soil data base. This must include a numerical rating for soil productivity or soil potential.

2.1. To perform a Land Evaluation:

- a. Select LE/soil from the Main Menu (see Figure 1.1).
This will bring the Land Evaluation Menu to the screen.

2.2. LE/wksheet - will initiate the LE worksheet commands. The user will be guided through the process by a series of questions. These questions will request that numerical data be entered from the keyboard.

- a. The first prompt requests the user to type in the site to be evaluated. There are 6 worksheets which can be used before the data must be stored, erased or written over. NOTE: Writing over data is not recommended. This may cause errors if old soil data is not all replaced by new data.

Type in the desired site: Site #(1-6), then press RETURN.

- b. The next prompt asks for the TOTAL ACRES FOR THE SPECIFIC SITE.

Type in the number of acres: (i.e. 640), then press RETURN.

- c. The third prompt asks for the number of the soil series. This number can be found in the MENU at the top of the screen. Each series (map symbol) has a corresponding number to the right.

Type in the appropriate number for the series and press RETURN.

- d. The fourth prompt asks for the number of acres that this soil series covers on the specific site.

Type in the number of acres for the soil and press RETURN.

If this is the last soil series type 999 and press RETURN.
This will return the menu to Step 2.

- e. To enter additional soil series information repeat steps c. and d. until complete, then enter 999 as in step d.

- 2.3. Repeat this procedure up to six times. After six sites the data must be erased or saved. Select REDO/LE to erase as many worksheets as necessary or select QUIT/save to save data. The Site Assessment worksheets for the same six sites should be completed prior to saving the data to avoid problems in recalling the data at a later date.
- 2.4. To correct an error in a worksheet select REDO and erase the appropriate worksheet and re-enter the correct data following the above sequence.
- 2.5. To print a paper copy of the Land Evaluation worksheet, select PRINT/LE.
- 2.6. To return to the Main Menu, select QUIT/LE.
- 2.7 Figure 2.2 shows the entire LE worksheet as it looks when generated from a dot matrix printer (shown at a reduced scale).

```

AM14: 'Site #1
LE/wrksheet PRINT QUIT/LE SAVE/LE REDO/LE PRINT/LE
Enter data into a LE worksheet.
  AL  AM  AN  AO  AP  AQ  AR
1  | POTTAWATOMIE COUNTY SOIL MAP SYMBOLS MENU
2  | Ce...1  Gm...5  Kf...9  Mu...13  Sq...17  We...21
3  | Em...2  Hn...6  Km...10  Os...14  Th...18  Wm...22
4  | Eu...3  Hs...7  Mo...11  Ot...15  Wb...19  Ws...23
5  | Ex...4  Kc...8  Mt...12  Pe...16  Wd...20  Zo...24
6  |
      AM      AN      AO      AP      AQ      AR
14 Site #1      TOTAL ACRES :
15 =====
16      MAP      MAP      ACRES      PROD      %TOTAL WEIGHTED
17      NUM      SYN      SERIES      RATING      ACRES      INDEX
18
19      ERR      ERR
20      ERR      ERR
21      ERR      ERR
22      ERR      ERR
23      ERR      ERR
24      ERR      ERR
25      ERR      ERR
26      ERR      ERR

```

Figure 2.1 LE worksheet and soil series symbol menu.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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3.0 - SITE ASSESSMENT - SA

*****BEFORE STARTING THE SITE ASSESSMENT WORKSHEET,
COLLECT ALL THE NECESSARY SITE DATA FOR THE
SPECIFIC SITES AND THE SURROUNDING AREAS.

- 3.1. To complete the Site Assessment worksheet select SA/site from the Main Menu which appears above the worksheet map (Figure 1.1).
- 3.2. Selecting SA/site will bring the SA worksheet and the opening menu to the screen.
 - a. The first prompt requests that the user enter the number of the site to be evaluated.

Type in the appropriate site number: Site (1-6) and press RETURN.

Note: Do not use the number sign (#), this is reserved for the LE worksheet name only.
- 3.3. After the site number is entered the macro commands take over. At the top of the screen there is a list of criteria which corresponds to the question in the lower part of the screen. Use the cursor keys to highlight the desired choice. Press the RETURN key to enter the desired criteria. The macro commands will enter the proper score and place the cursor in the nt data entry cell beside each subsequent site factor.
 - a. Follow the above procedure for each of the 18 site factors.
 - b. The computer will automatically sum the weighted scores and display the total at the bottom of the column for each site.
- 3.4. Follow steps 2 and 3 for each site to be evaluated. Up to six sites can be evaluated (same as the LE worksheet) prior to saving, erasing or overwriting data. Note: It is not advisable to overwrite data...this can result in errors in the LESA scores.
- 3.5. To correct an eronious entry, select REDO/SA from the opening Site Assessment Menu.
- 3.6. To get a printout of the SA worksheet, select PRINT/SA.
- 3.7. To save the data select QUIT/save. Prior to saving the data the user should be advised to have completed the Land Evaluation worksheet. This will avoid confusion in recalling the data for evaluation at a later date.
- 3.8. Figure 3.1 illustrates the user's view of the SA worksheet on the computer monitor.
- 3.9. Figure 3.2 shows the entire SA worksheet as it would appear when printed out using a dot matrix printer (shown at a reduced scale).

100-90% of land within 1/2 mile is under production = 10 pts.

A	B	C	D	E	F	G
1	*****KANSAS STATE UNIVERSITY-DEPARTMENT OF LAND SCAPE ARCHITECTURE					
2	SITE ASSESSMENT WORKSHEET					
3	POTTAWATOMIE COUNTY EVALUATION					
4	SITE ASSESSMENT FACTORS - PART 11					
5						
6						
7						
8	1. Percent of agricultural use					
9	within 1/2 mile of proposed site?					
10						
11						
12	2. Percent of land adjacent to site					
13	in agriculture?					
14						
15	3. Percent of site in agricultural use?					
16						
17						
18	4. Percent of land zoned agriculture					
19	within 1/2 mile?					

Figure 3.1 Monitor view of Site Assessment worksheet.

SITE EVALUATION TEMPLATE (THIS IS EXAMPLAR - NOT A FINAL)													
SITE FACTORS FOR ASSESSMENT - PART II	SITE A1		SITE A2		SITE A3		SITE A4		SITE A5		SITE A6		POINT WEIGHTED VALUE
	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE	POINT WEIGHTED VALUE
1. Percent of agriculture, use within 1/2 mile of proposed site?	10	9.47	9	8.72	8	8.01	8	8.01	8	8.01	10	9.47	
2. Percent of land adjacent to site is agriculture?	10	17.38	9	15.52	10	17.38	10	17.38	9	15.52	10	17.38	
3. Percent of site in agricultural use?	10	11.52	9	10.24	10	11.52	10	11.52	10	11.52	10	11.52	
4. Percent of land zoned agriculture within 1/2 mile?	10	12.44	9	12.96	8	8.04	8	8.04	8	8.04	9	12.96	
5. Availability of acreage, approximately zoned land?	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72	
6. Impact of the proposed conversion on the retention of river sq. (acres)?	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68	
7. Impact on drainage, floodplain and water quality?	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68	5	7.68	
8. Impact on air quality or noise?	5	3.84	5	3.84	5	3.84	5	3.84	5	3.84	5	3.84	
9. Impact on historical/cultural and recreational open space?	5	3.76	5	3.76	5	3.76	5	3.76	5	3.76	5	3.76	
10. Municipal water supply is available.	9	10.24	9	10.24	9	10.24	9	10.24	9	10.24	9	10.24	
11. Municipal sewer service is available.	10	7.68	10	7.68	10	7.68	10	7.68	10	7.68	10	7.68	
12. Compatible with comprehensive plan.	5	9.6	5	9.6	5	9.6	5	9.6	5	9.6	5	9.6	
13. The site is suitable for the proposed development scheme.	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	5	4.8	
14. Agricultural support systems or infrastructure serve the site.	10	3.24	10	3.24	10	3.24	10	3.24	10	3.24	10	3.24	
15. Environmental resource	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72	5	6.72	
16. Location of the site.	10	12.44	10	12.44	5	6.72	5	6.72	10	12.44	10	12.44	
17. Transportation (accessibility of site)	9	8.64	10	9.6	5	3.28	5	3.28	9	8.64	9	8.64	
18. Proximity to facilities	5	0	5	0	5	0	5	0	5	0	5	0	
SITE EVALUATION TOTALS =													
	113	141.276	125	129.648	109	122.744	109	122.744	110	124.276	113	122.744	

Figure 3.2 Paper printout of Site Factor worksheet (reduced scale).

SHAWNEE COUNTY LESA SITE ASSESSMENT FACTORS WORKSHEET
THEIS DRAFT TEMPLATE
LESA (SA)

SITE FACTORS FOR ASSESSMENT OF AGRICULTURAL LAND	Maximum points per Factor	Weight Assigned Points	Adjusted weights	Adjusted Ratio
Percent of agricultural use within 1/2 mile of proposed site?	10	50	0.96	9.6
Percent of land adjacent to site in agriculture?	10	90	1.728	17.28
Percent of site in agricultural use?	10	60	1.152	11.52
Percent of land zoned agriculture within 1/2 mile?	10	70	1.344	13.44
Availability of adequate, appropriately zoned land?	10	70	1.344	13.44
Impact of the proposed conversion on the retention of other ag lands?	10	80	1.536	15.36
Impact on drainage, floodplain and water quality?	10	80	1.536	15.36
Impact on air quality or noise?	10	40	0.768	7.68
Impact on historical/cultural and recreational open space?	10	10	0.192	1.92
Municipal water supply is available.	10	60	1.152	11.52
Municipal sewer service is available.	10	40	0.768	7.68
Compatible with comprehensive plan.	10	100	1.92	19.2
The site is suitable for the proposed development scheme.	10	50	0.96	9.6
Agricultural support systems or infrastructure serve the site.	10	20	0.384	3.84
Economic/social importance	10	70	1.344	13.44
Location of the site.	10	70	1.344	13.44
Transportation to/Accessibility of site	10	50	0.96	9.6
Proximity of Utilities?	10	30	0.576	5.76
		1040		199.68
				= Adjusted Weight (199.68/1040)

Figure 3.2.a "What IF?" Model Template

4.0 - SUMMARY SHEET

- 4.1. To review the LESA scores and compare site values select SUMMARY from the Main Menu.
- 4.2. The user can either return to the Main Menu to do another task or print a copy of the Summary sheet.
 - a. To print a copy of the Summary sheet, select PRINT.
 - b. To return to the Main Menu, select MAINMENU.
- 4.3. If the computer has graphics capability, the user may look at a graph of the LESA scores.
 - a. To view the graph press the F10 function key.
- 4.4. Figure 4.1 shows an example of the Summary sheet. It shows the Land Evaluation scores, the Site Assessment scores and the LESA score for each of the six sites.
- 4.5. Figure 4.2 illustrates the printout of a graph showing the summary of a LESA evaluation.

C110:

READY

	C	DE	F	G	H	I
91	LAND EVALUATION AND SITE ASSESSMENT					
92	SUMMARY SHEET					
93	TEMPLATE III					
94	===== OPTIMUM LESA SCORE = 300 =====					
95	COMPOSITE SCORES SHOWN ARE FROM: SOILS + SITE = LESA					
96					
97	POTTAWATOMIE (WAMEGO) SITE #1	66	134	200		
98	POTTAWATOMIE (WAMEGO) SITE #2	65	138	203		
99	POTTAWATOMIE (WAMEGO) SITE #3	73	137	210		
100	POTTAWATOMIE (WAMEGO) SITE #4	61	124	185		
101	POTTAWATOMIE (WAMEGO) SITE #5	69	140	209		
102	POTTAWATOMIE (WAMEGO) SITE #6	54	107	161		
103	POTTAWATOMIE (WAMEGO) SITE #7	58	144	202		
104	POTTAWATOMIE (WAMEGO) SITE #8	33	140	173		
105	POTTAWATOMIE (WAMEGO) SITE #9	33	122	155		
106	POTTAWATOMIE (WAMEGO) SITE #10	42	122	164		
107	POTTAWATOMIE (WAMEGO) SITE #11	28	124	152		
108	POTTAWATOMIE (WAMEGO) SITE #12	94	134	228		
109	POTTAWATOMIE (WAMEGO) SITE #13	94	122	216		
110						

Figure 4.1 Summary sheet example.

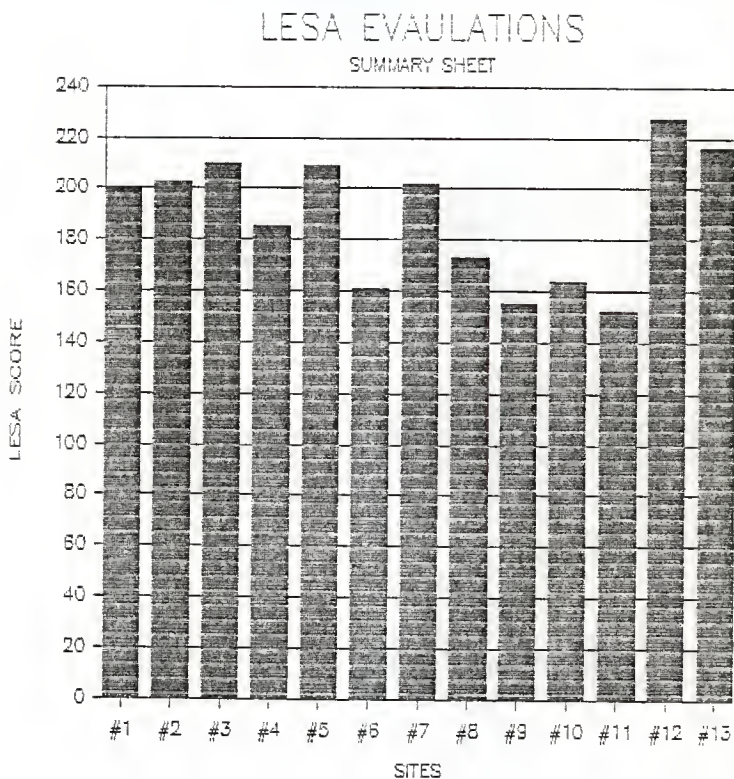


Figure 4.2 Example of a graph generated by pressing the F10 key.

5.0 RANGE NAMES

- 5.1 DBASE - Soil Data Base.
- 5.2 LABELS - Criterion Location and Criterion Names.
- 5.3 MACROS - Top of the Macro--Menu range.
- 5.4 MAINMENU - Entry Menu.
- 5.5 MAP - Location Map showing the location of all work areas.
- 5.6 MENU 2.1-2.18 - Site Assessment Menus.
- 5.7 MENU 3.1 - Land Evaluation worksheet Macro and Menu.
- 5.8 MENU 4.0 - Shawnee County Model "What if?" Menu.
- 5.9 MODEL - Shawnee County Model of Site Factor weighting criteria.
- 5.10 SITE 1-6 - Site Factor worksheets (each of the 6 work areas has a name).
- 5.11 SITE #1-#6 - Land Evaluation worksheets.
- 5.12 SUMMARY - LESA Summary worksheet.
- 5.13 sitelwa-site6wa - use these range names to "Range Erase" the data in the Land Evaluation worksheets.
- 5.14 MACRO NAMES:
 - \0 - The automatic start macro - cannot be called from the keyboard.
 - \A - The Main Menu macro.
 - \B - The Site Assessment macro.
 - \Z - The Land Evaluation macro.

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AGRICULTURAL LAND EVALUATION:
THE ADAPTATION OF THE LAND EVALUATION
AND SITE ASSESSMENT SYSTEM TO THE MICROCOMPUTER

BY

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AN ABSTRACT

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1985

ABSTRACT

Agricultural Land Evaluation: The Adaptation of the Land Evaluation and Site Assessment System to the Microcomputer

In the late 1970's and the early 1980's the issue of agricultural land losses to nonagricultural development was brought to national attention. Acting on the findings of the National Agricultural Lands Study, Congress passed the Farmland Protection Act-Public Law 97-98 in December of 1981.

The Farmland Protection Act gave the Soil Conservation Service (SCS) the responsibility of implementing a method to identify and evaluate agricultural land for protection under this act as well as similar state and local legislation. The SCS in conjunction with state and local planners and officials developed a two-part system for determining the value of individual parcels or sites. Areas being considered for conversion to nonagricultural use could be evaluated using this method to determine the relative value of the site to the local agricultural land base and economy. This system is known as the Land Evaluation and Site Assessment System or LESA.

The intent of this study was to adapt the LESA system to a microcomputer (IBM-PC or compatible). By adapting the LESA concept to the microcomputer the system could be made more flexible and faster in calculating the necessary "scores". This would facilitate the use of the system for forecasting the effect of proposed nonagricultural projects on the farmland base of the community. The primary goal in the adaptation process was to leave the LESA relatively simple to use for either professional planners or elected community officials dealing with agricultural land planning issues.

Using an electronic spreadsheet program (LOTUS 1-2-3), allowed the LESA worksheets to be entered into the computer in a format similar to the way they appear on paper. The spreadsheet format permits the user to enter data onto computer worksheets in the same fashion they might enter data onto a paper worksheet using a typewriter.

LOTUS 1-2-3 provided the necessary computer capability to incorporate a soil data base with the LESA concept. This soil data base enhancement, in essence, upgrades the LESA system to a geographic information system (GIS) for the evaluation of agricultural land.

A case study was used to evaluate the LESA/LOTUS information system. Thirteen parcels of agricultural land were selected from an area in Pottawatomie County, Kansas for LESA evaluation. The Land Evaluation (LE) was based on data supplied by the SCS in the Pottawatomie County Soil Survey Report. The Site Assessment (SA) was completed using the site factors taken from the LESA program criteria developed for neighboring Shawnee County, Kansas.

The results of the study indicate that the original LESA worksheets are very compatible with the LOTUS spreadsheet. The computer versions of the worksheets appear on the computer monitor in the same basic form as they do on paper. The only changes necessary in the basic layout were done to accommodate the LE data extracted from the data base. The computer LESA System is faster

than the manual process using paper, pencil, and calculator. The user enters the required data and the computer does the calculations. The system is more flexible in several ways. The addition of the data base permits easy access to the necessary soil data without having to perform the task of manually looking up the necessary data each time an evaluation is done. The values assigned to the site factors can be changed individually. This forecasting can be done to see what effect certain changes in site conditions might have on the overall LESA score. These changes can be accomplished without having to manually recalculate. The computer does the recaluculation and the results are seen immediately.

The computer adapted LESA system has shown an increase in the effeciency and a decrease in the time generally allocated to the assessment of agricultural land using the pencil, paper and calculator method. Based on reactions of individuals who have seen and used the computer version of LESA, it is a convenient method for decision-makers to evaluate several land use alternatives in a short period of time.